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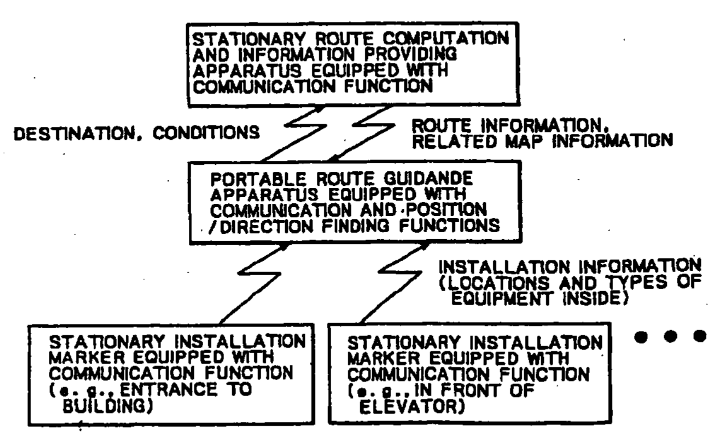
(54) DATA PROCESSING APPARATUS AND NAVIGATION SYSTEM FOR PEDESTRIANS USING THE SAME

(57) This invention relates to techniques for supporting pedestrians on the move with information and, more particularly, to a pedestrian navigation system for navigating pedestrians by supplying them with information about their positions and position-related information. The system comprises a route computation apparatus having pedestrian-oriented map information for pedestrian route guidance, a portable route guidance apparatus, and markers located in an installation. Also included in the system is a medium translation function for translating input information of a given medium to information of another medium for output depending on current status of a pedestrian, whereby the information of interest is translated into information in a format suitable for the state in which the pedestrian is utilizing the portable apparatus. This provides a detailed route guidance service allowing the pedestrian to reach a target location in a specific installation. Because the system permits automatic changing of modes for information exchanges depending on the user's status of activity such as walking, working, and participation in a meeting, necessary information is made available in a status-compatible format on a sufficiently detailed basis.

FIG. 1



EP 1 081 462 A1

Description

TECHNICAL FIELD

[0001] The present invention relates to techniques for supporting pedestrians on the move with information. More particularly, the invention relates to a pedestrian navigation system for navigating pedestrians by supplying them with information about their positions and position-related information.

BACKGROUND ART

[0002] Conventional systems for transmitting information to pedestrians include mobile telephones, portable computers, portable information communication systems linking a mobile telephone and a portable computer, and car navigation systems used in a detachable manner as route guidance systems for pedestrians or motorcycle riders. Information is made available in multimedia forms. These systems are ushering in an era where users can obtain desired multimedia information anytime, anywhere.

[0003] The basic assumption for such systems is that users on the move come to a stop when performing necessary manipulations to exchange information; information cannot be sent or received by users who are still on the move or at work. Transmitted information is received and reproduced with its attributes (images, text, patterns, voice, etc.) unmodified (i.e., image-attribute information is received as images, text information as text, pattern information as patterns, voice information as voice). The attribute-bound nature of reproduction has made it difficult for traveling or working users of the system to send or receive information adequately. The system also has had difficulty in effectively transmitting information to visually, auditorily or otherwise disabled users.

[0004] Route guidance systems based on transmitted information utilize the type of information employed by car navigation systems. For that reason, pedestrians using such systems have not received information detailed enough to navigate them through, say, the interior of a building.

DISCLOSURE OF INVENTION

[0005] According to the invention, transmitted information based on any given medium is translated into the medium format best suited for the system user's mode of activity at the moment. For example, information based on diverse media is translated into voice to let pedestrian users make better use of the translated information. Visually disabled users may be offered not only voice-attribute information but also information based on other media which is translated into a format suitable for the situation where the information is received. Such a medium translation function is implemented by use of a facility for dispatching on a real-time basis real-time medium recognition functions and real-time medium composition functions in accordance with the user's mode of activity at the transmitting or receiving side.

[0006] Detailed route guidance is implemented by installing at street corners and inside buildings information transmitters for transmitting electronically coded directional information as well as attribute information at least about the locations involved (name of a given building, its entrance, reception desk, elevators, etc.). The transmitted information is received by a telecommunication terminal held by each user. Based on field intensities and other parameters, the terminal computes the distance to a target location. By matching the computed information with route information stored inside, the terminal provides the user with route guidance not only outdoors but also inside a given building.

BRIEF DESCRIPTION OF DRAWINGS

[0007]

Fig. 1 is a schematic view outlining a configuration of a system embodying the invention.

Fig. 2 is a block diagram showing a system configuration of a stationary route computation apparatus equipped with a communication function.

Fig. 3 is a block diagram depicting a system configuration of a portable route guidance apparatus equipped with communication and position direction finding functions.

Fig. 4 is a block diagram of an installation marker equipped with a communication function.

Fig. 5 is a schematic view showing how route guidance is typically provided conventionally.

Fig. 6 is a schematic view illustrating how route guidance is typically provided according to the invention.

Fig. 7 is a typical map outlining the inside of an installation.

Fig. 8 is a schematic view showing how an installation marker is typically mounted.

Fig. 9 is a side view depicting how an installation marker is typically mounted.

Fig. 10 is a plan view illustrating how an installation marker is typically mounted.

Fig. 11 is an external view of a communication function-equipped stationary route computation apparatus.

Fig. 12 is a schematic view showing typical situations in which information based on some media cannot be transmitted.

Fig. 13 is a schematic view sketching how information is typically translated between media.

Fig. 14 is a schematic view indicating how information is basically translated from one medium to another.

Fig. 15 is a block diagram of an information processing apparatus embodying the invention.

Fig. 16 are tabular views listing parameters of a road map and an installation map.

Fig. 17 is a tabular view listing parameters of a route map.

Fig. 18 is a flowchart of steps representing Dijkstra's method.

Fig. 19 is a block diagram of a modified portable route guidance apparatus for use both on a car and by a pedestrian.

Fig. 20 is a flowchart of steps for analyzing route statements.

Fig. 21 is a flowchart of steps for extracting word candidates.

Fig. 22 is a flowchart of steps for matching keywords.

Fig. 23 is a flowchart of steps for generating a word string.

Fig. 24 is a set of views showing a typical route guidance statement, keywords, analyzed results of a route statement, and patterning.

Fig. 25 is a flowchart of steps constituting a drawing process.

Fig. 26 is a schematic view showing a pattern drawing example.

Fig. 27 is a schematic view showing another pattern drawing example.

Fig. 28 is a schematic view showing another pattern drawing example.

Fig. 29 is a schematic view showing another pattern drawing example.

Fig. 30 is a schematic view showing another pattern drawing example.

Fig. 31 is a table of correspondence between sensor outputs on the one hand and information media subject to translation on the other hand.

Fig. 32 is a schematic view depicting a typical structure of an optical sensor

Fig. 33 is a schematic view indicating a typical structure of an acceleration sensor arrangement.

Fig. 34 is a schematic view sketching a typical structure of a sound volume sensor.

Fig. 35 is a flowchart of steps constituting a process performed by a user activity recognition processing part.

Fig. 36 is a flowchart of steps constituting a process carried out by a medium translation control processing part.

BEST MODE FOR CARRYING OUT THE INVENTION

[0008] Fig. 1 shows a typical configuration of a system embodying the invention. The system comprises a stationary route computation and information providing apparatus 1 equipped with a communication function (called the information providing apparatus 1 hereunder), a portable route guidance apparatus 2 equipped with communication and direction finding functions (called the route guidance apparatus hereunder), and a stationary installation marker 3 equipped with a communication function (called the marker hereunder). In operation, a user (pedestrian) carries the route guidance apparatus 2 around. When the pedestrian sends his or her current position and an intended destination through the route guidance apparatus 2 to the information providing apparatus 1, the apparatus 1 computes an appropriate route using necessary databases (maps, etc.) and sends the computed route information back to the route guidance apparatus 2. The pedestrian then moves toward the destination by following the transmitted route information presented by the route guidance apparatus 2. On his way to the destination, the pedestrian may receive on his route guidance apparatus 2 information from markers 3 mounted at an entrance to a building, at its elevator, and at other locations of the installation of interest. The marker-originated information helps provide the pedestrian with detailed route guidance.

[0009] Fig. 2 depicts a typical system configuration of the information providing apparatus 1 according to the invention. The information providing apparatus 1 comprises a route computing part 11 for acquiring a suitable route using pedestrian-oriented databases (e.g., a digital road map database 15 for pedestrians, an installation map database 16 containing information about structures and stores inside buildings, a transport network and, timetable database 17 about public transportation, and a road repair and traffic control database 18 as well as a traffic accident and obstruction database 19 containing information about obstacles to pedestrian movements) and in response to requests from the user (current position, intended destination, etc.). The information providing apparatus 1 also includes: an information selecting part 12 for selecting necessary information in response to a request for installation guidance information; a guidance information generating part 13 for generating necessary guidance information by putting together information obtained by the route computing part 11 and information selecting part 12; and a communicating part 14 for communicating with the route guidance apparatus 2 carried by the user.

[0010] Fig. 3 sketches a typical system configuration of the route guidance apparatus 2 according to the invention. The route guidance apparatus 2 is driven by batteries and comprises: a communicating part 201 for communicating with the information providing apparatus 1 and markers 3; a communication data storing part 202 for recording communication data for storage; an information navigation part 203 for generating not only communication information to be sent to the information providing apparatus 1 but also guidance information destined for pedestrians based on the route information from the apparatus 1, on current position information from a current position and advancing direction measuring part 211 (direction information supplied from a direc-

tion sensor 208, current position fed from a GPS receiver 209), and on installation marker direction information from an emitter direction and distance measuring part 212 (connected to a beam receiver 210 receiving installation ID and beam emission direction information from the marker 3); a user activity recognizing part 207 for recognizing the user's walking activity (whether the route guidance apparatus 2 is held by hand or placed in a bag; whether the pedestrian is walking, running or at rest) by resorting to an optical sensor 205 mounted on a side of the route guidance apparatus 2 or to a walking sensor 206 constituted by acceleration sensors or the like; a medium translation controlling part 204 which translates user-originated information of a given medium into a medium format accessible by the information navigation part 203 in keeping with the output from the user activity recognizing part 207, and which translates guidance information from the information navigation part 203 into a medium format accessible by the user; and a group of I/O devices connected to the medium translation controlling part 204 (e.g., display 213, speaker 214, vibrator 215, microphone 216, tablet 217, keyboard 218).

[0011] Fig. 11 is an external view of the route guidance apparatus 2. The apparatus 2 is made up of a flat display 213 overlaid with a touch-sensitive panel, a GPS antenna 209, a beam receiver 210, a communication antenna 201, a speaker 214 and a microphone 216. The GPS antenna 209 and communication antenna 201 can become unstable in operation upon interfering with each other depending on the frequencies of radio waves being used. The potential trouble is averted by mounting the two antennas well apart as illustrated, or by setting up a common antenna for receiving signals that may be suitably separated inside.

[0012] Fig. 4 depicts a typical system configuration of the marker 3 according to the invention. The marker 3 comprises: at least a set of angle information multiplexing parts 34, 35 and 36 which store installation information and which are connected to an information generating part 37 for outputting information; and beam emitters 31, 32 and 33 connected respectively to the angle information multiplexing parts 34, 35 and 36. A communicating part 38 may be provided for connection to an external information controlling apparatus whereby modification of installation information from the information generating part 37 is facilitated. If the beam emitters are designed to use optical beams, each beam emitter may illustratively utilize a lens system to restrict its range of beam emission. Beam angles may be determined illustratively on a 360-degree direction gauging arrangement, graduated clockwise with reference to the map direction of the north being set as zero. Where beams carry such angle information, the route guidance apparatus 2 receiving a given beam can readily determine the direction in which to guide the user. The markers 3 are furnished at an entrance to a building, at staircases inside, at an elevator, at the reception desk and other strategic points of the interior for route guidance. As shown in Fig. 8, a marker 3 is mounted illustratively above the reception desk as a beam emitter for emitting beams in three directions. Fig. 9 is a side view depicting how the marker is mounted, and Fig. 10 illustrates the mounting of the marker as viewed from above. Desired beam patterns are obtained by a suitable lens system if the beam emitter uses an optical beam or by an appropriate antenna arrangement if the beam emitter employs radio waves.

[0013] Described below with reference to Figs. 5 through 7, Figs. 16 through 18 is a procedure for computing the route from a starting point (Figs. 5 and 6) to a goal (e.g., second exhibition room on the third floor of ○○○ Museum). Traditionally, route guidance has been targeted mainly for vehicles. Where a destination is established for such vehicular route guidance, the routing takes place along roads. An actual system may guide the user up to the road closest to the goal as shown in Fig. 5. A navigation system used by a pedestrian, on the other hand, is required to guide the user into the target building as depicted in Fig. 6. The requirement is met by provision of installation maps such as those shown in Fig. 7. Because outdoor-use positioning devices represented by GPS cannot be used inside buildings, guidance in the building interior requires setting up direction emitters such as markers 3 at strategic locations inside the installation. Fig. 16 lists typical database records of a road map and an installation map. In addition to traditional indications of crossings (C1, C2, C3, C4, etc.), Fig. 16(a) includes accessibility information for pedestrians and links to markers located at entrances to installations such as buildings. Besides the crossing locations, Fig. 16(b) includes positions of markers inside the installations, beam emission directions, and link information (IDs of adjacent markers).

[0014] Where route computations are carried out by use of the road and installation maps shown in Fig. 16, a procedure for routing along roads is separated from a procedure for routing inside installations. For the road routing, a road-bound goal is established at a mediating location "m" on the road. If the ultimate goal is located inside an installation, the ID of an adjacent road point is obtained from the link information in the installation map. In computation, the route along the roads (i.e., from the starting point through C1, C3, C4 and m) is first acquired, followed by the route inside the installation (passing through m, mh, mf1, me, mf3 and mf3r2).

[0015] Fig. 18 is a flowchart of steps constituting Dijkstra's algorithm, a representative algorithm for route computation. Using the starting point as its initial value, the algorithm obtains minimum appraised values such as distances from one point to the next (nodes) until a goal is reached. Eventually a route represented by the minimum appraised values from the starting point to the goal is obtained. If a route inside a multiple-story installation needs to be acquired, as in the current example of

the invention, there is no need to compute routing on all floors. That is, the computing time is reduced by searching through only the map of the floor where the goal is located.

[0016] Fig. 17 is table that lists typical results of route computations in this example. In terms of route information, the table includes ID names of mediating locations, positions of the mediating locations, approach angles to the mediating locations, and departure angles from the mediating locations. The two kinds of angle information are provided to help obtain the correct advancing direction, allowing for pedestrians' general tendency to change their bearings in an extremely erratic fashion, e.g., looking sideways and backwards while walking.

[0017] On the basis of the route information listed in Fig. 17, the route guidance apparatus 2 carried by the user guides him or her from the starting point to the goal. While operating outdoors, the apparatus 2 compares the route information with the current position and advancing direction derived from GPS. Once inside an installation (e.g., ○○○ Museum), the route guidance apparatus 2 cannot resort to GPS and relies instead on beams received from emitters for continuous guidance. The received beams reveal angle information which is translated into the direction, while the current position is acquired by measuring the intensity of the beams. Such a guidance method based on GPS and beam emissions may be applied illustratively to a system for guiding a vehicle from the streets into an underground parking lot. The method is also applicable to a system for physical distribution at port facilities, guiding containers from container yards to appropriate locations in the holds.

[0018] An information translation function will now be described with reference to Figs. 12 through 15. Today's information services are offered typically in a multimedia format. That is, sets of information are expressed using multiple media such as characters, patterns, images and voice. Of these types of information being offered, visual information cannot be fully utilized by people at work (e.g., while walking) because, as shown in Fig. 12, their attempts to make use of such information could lead to an accident. In a crowded situation (e.g., a meeting), voice information can disturb people near the person receiving it. Such impediments to information availability also apply to visually disabled people being presented with visual information or to auditorily disabled people being offered voice information.

[0019] In such cases, as illustrated in Fig. 13, the medium translation function translates the information of interest into information with an attribute accessible by the pedestrian (user) on the basis of the actual or judged state of activity of the pedestrian (user).

[0020] Basically, the medium translation function involves translating information of a given medium A into text by use of recognition techniques and reproducing information of a target medium using composition techniques, as shown in Fig. 14. Because the inventive apparatus determines into which medium to translate information of a given medium in accordance with the state of the pedestrian (user), the apparatus is illustratively constituted as shown in Fig. 15. Specifically, the constitution of Fig. 15 is acquired by supplementing the setup of Fig. 14 with a medium translation table that defines into which medium input information of a given medium is to be translated. The constitution primarily comprises: a multimedia information receiving part 151 for receiving multimedia information and the like; a medium translation module 152 (or information translating part) for translating the information received by the multimedia information receiving part 151; and a multimedia information outputting part 153 for outputting information translated by the medium translation module 152. The medium translation module is made up of a use status detecting part 154 for detecting the use status of the user utilizing the apparatus; a use status judging part 155 for judging the use status of the user on the basis of detected results from the use status detecting part 154 and in accordance with a medium translation table 157 defining beforehand which detected values from the use status detecting part 154 correspond to which user status; and an information translating part 156 for translating information received by the multimedia information receiving part 151 in a manner relevant to the judgment by the use status judging part 155. The use status detecting part 154 may be implemented illustratively in the form of an optical sensor, acceleration sensors, a sound volume sensor that measures the volume of sound picked up by microphones, or a temperature sensor. The medium translation table 157 may be established illustratively by sensors (205 and 206 in Fig. 3) which as a portion of the use status detecting part 154 obtain the user's status of activity, or by the pedestrian (user) issuing explicit settings (through menus, etc.). For example, if the optical sensor detects a low level of light (at a dark location), the apparatus is judged to be currently placed in a bag or the like. In that case, the information of interest is output by voice through earphones or the like. If the optical sensor detects a high level of light (at a well-lighted location) and if, say, acceleration sensors detect a stationary state through vibration analysis, the user is judged to be carrying the route guidance apparatus 2 by hand. In such a case, image information is provided unmodified. In this manner, the manner of offering information is changed automatically depending on the situation in which the information of interest is to be provided. If a microphone picks up an appreciably, high level of ambient noise, then voice information indicating that location C3 is closed to traffic because of road repairs may be translated through voice recognition illustratively into characters for visual display. The information may be further analyzed and divided into "the location C3" on the one hand and "the closed traffic sit-

uation" on the other hand, which may be turned into "a closed traffic" indication on a road map through medium-to-medium translation. When information of a given medium is translated by the medium translation function into information of at least one other medium, desired information is offered to users with a minimum loss of informative ingredients regardless of the situation they find themselves in at a given moment. This allows the users to be more efficient than before in acquiring necessary information.

[0021] Fig. 19 is a partial block diagram of a modified portable route guidance apparatus for dual use both on a car and by a pedestrian. In the setup of Fig. 19, a user activity recognizing part judges whether the user is walking or driving a car, and sends the judgment to a communicating part. Depending on the user's state thus determined, the user activity recognizing part causes the communicating part to select either a database for pedestrians or a database for vehicles and to acquire suitable information therefrom. The setup allows the user to obtain route information in each of his or her two possible states of activity.

[0022] Described below with reference to Figs. 20 through 30 is how a route map is generated illustratively from a route guidance statement.

[0023] The statement may be one in Fig. 24, specifying a route from "station A ... to building B." It is assumed here that the route guidance statement "from station A ... to building B" is stored in advance as text information. The following processes are carried out to obtain eventually a route map such as one shown in Fig. 30.

[0024] Four steps shown in Fig. 20 are initially carried out to translate the route guidance statement in question into a string of words destined for patterning.

[0025] In the first step, word candidates are first extracted from the route guidance statement, as shown in Fig. 21. Extraction of each word is made easier illustratively by picking up characters of the same type.

[0026] In the second step, as depicted in Fig. 22, each of the word candidates is compared with keys ("KEYS" in Fig. 24). When a word candidate is matched with a key, the attribute (position, direction, route, distance, etc.) of the key is attached to the word candidate in question.

[0027] In the third step, as indicated in Fig. 23, the words are rearranged in terms of a starting point, directions, routes, and distances up to the destination, in that order, with emphasis on word consistency and logic ("PATTERNING" in Fig. 24).

[0028] In the fourth step, the word strings above are patterned in the steps shown in Fig. 25.

[0029] First, the orientation and an approximate scale of a map to be drawn are established (step 25-1). The initial starting point is set in a mediating location buffer (step 25-2). This mediating location is set close to the center of the map screen (step 25-3). In this state, an initial screen for the map to be drawn is set in a display memory. Thereafter, steps 25-4 through 25-13 below will be repeated until the mediating location coincides with the destination.

[0030] Station A is first extracted as the starting point from among the word strings for patterning (step 25-4). The location is written to the display memory in the form of a predetermined symbol or a pattern as shown in Fig. 27 (step 25-5). The direction (north), route (main street) and distance (300 m) are extracted. If a routing line is judged to be capable of being drawn on the screen on the initially established scale (step 25-9), then a vector of the set distance from the starting point in the established direction and a name of the route are drawn (steps 25-10, 25-11). This creates a drawing of Fig. 28 in the display memory. The next mediating location (crossing) is extracted (step 25-12). Step 25-4 is then reached again for another pass of patterning. If the drawing range is found in step 25-9 to exceed the settings, step 25-15 is reached in which the scale is suitably modified. Illustratively, when the distance is acquired from the initial starting point to the tip of the vector, the scale may be set for double the ratio of the acquired distance to the set distance. This creates drawings of Figs. 29 and 30. The final pattern of the building B is drawn in step 25-14.

[0031] In the manner described above, a route map may be generated from a route guidance statement. Route guidance statements are obtained illustratively through kana-kanji translation with a keyboard, voice recognition, hand-written character recognition, and off-line image recognition. The route guidance statements thus obtained may each be announced through speech synthesis or drawn in patterns through the above-described processing.

[0032] Where light intensity information from an optical sensor, motion information from acceleration sensors, and sound volume information from microphones are used to judge the status of the apparatus, the processing of status judgment by use of such activity sensors will benefit from a classification table such as one shown in Fig. 31. The table, which defines into which medium to translate information of a given medium in each of differently judged states, is retained in a memory area accessible by a user activity recognition processing part 206.

[0033] Figs. 32 through 34 schematically show typical structures of various sensors. Fig. 32 indicates a typical structure of the optical sensor. Output voltages of the sensor are subjected to analog-digital conversion (A/D conversion in Fig. 32) by use of a photo-transistor arrangement or the like. The converted voltages are retained in a buffer and retrieved as needed by the user activity recognition processing part 206. If the optical sensor is mounted in parallel with a display surface, the output of the optical sensor is generally increased while the user is watching the display. In that case, a "high" level of light intensity is recognized. If the apparatus is placed in a bag or the like, the output of the optical sen-

sor drops. Then a "low" level of light intensity is recognized.

[0034] Fig. 33 shows a typical structure of a three-axis acceleration sensor arrangement. Outputs of the individual sensors are subjected to analog-digital conversion before being placed into buffers. The buffer contents are selected as needed by a selector and retrieved by the user activity recognition processing part 206.

[0035] Fig. 34 outlines a typical structure of a microphone sensor. The microphone output, which is generally in alternating-current form, is rectified by a rectifying circuit into direct-current form. The resulting DC values are subjected to analog-digital conversion before being placed into a buffer. As in the case of the above-mentioned sensors, the buffer contents are selected by a selector as needed and retrieved by the user activity recognition processing part 206.

[0036] Fig. 35 shows a process flow of the user activity recognition processing part 206. First, the sensor outputs are retrieved (steps 206-1 through 206-3). The processing part 206 then references the classification table to select the applicable state (step 206-4). An appropriate mode for information medium translation is selected and sent to the medium translation controlling part 204.

[0037] Fig. 36 shows a process flow of the medium translation controlling part 204. First, the information of interest is acquired (step 204-1). A check is made to see if the translation mode corresponding to the acquired information is other than a "no translation" mode (step 204-2). If translation is judged to be necessary, then the information is translated into a target medium through a recognition process (step 204-3). For example, if voice information needs to be translated into character information, the information of interest is translated into character strings through a voice recognition process. A character recognition process or an image recognition process is also utilized as needed. Thereafter, a composition process is carried out for output (step 204-4). In this example, a procedure of translating the character strings into outline fonts corresponds to the composition process. Speech synthesis or pattern drawing is also employed as needed.

INDUSTRIAL APPLICABILITY

[0038] As described, the pedestrian navigation system according to the invention provides a detailed route guidance service allowing pedestrians to reach a target location in a specific installation. In addition, the inventive system permits automatic changing of modes for information exchanges depending on the user's status of activity such as walking, working, and participation in a meeting, whereby necessary information is made available in a status-compatible format on a sufficiently detailed basis.

Claims

1. An information processing apparatus for converting received information for output, comprising:

   a receiving part for receiving information;
   a detecting part for detecting a use state of a user making use of said information processing apparatus;
   a translation table defining beforehand relations of correspondence between a detected result from said detecting part and said use state of said user;
   a judging part for judging said use state of said user based on said detected result from said detecting part and on said translation table;
   an information translating part for translating the information received by said receiving part in accordance with a judged result from said judging part; and
   an outputting part for outputting the translated information coming from said information translating part.

2. An information processing apparatus according to claim 1, wherein said detecting part is at least any one of an optical sensor, an acceleration sensor and a microphone.

3. An information processing apparatus according to claim 2, wherein said detecting part is constituted by at least said optical sensor, and wherein said translation table is established in such a manner that if measurements taken by said optical sensor indicate a low level, then said judging part causes said information translating part to put the received information into voice form for output.

4. An information processing apparatus according to claim 2, wherein said detecting part is constituted by at least said optical sensor and said acceleration sensor, and wherein said translation table is established in such a manner that if measurements taken by said optical sensor indicate a high level, if vibration analysis by said accelerator sensor denotes a stationary state, and if the received information is image information, then said judging part causes said information translating part to output said received information without translation to said outputting part.

5. An information processing apparatus according to claim 2, wherein said detecting part is constituted by at least said microphone, and wherein said translation table is established in such a manner that if measurements taken by said microphone exceed a predetermined threshold value, then said judging part causes said information translating

part to translate the received information into character information for output.

6. A pedestrian navigation system for transmitting information to a portable pedestrian guidance apparatus carried by a pedestrian so that the portable apparatus outputs the transmitted information to navigate said pedestrian, said pedestrian navigation system comprising:

   a route computation information providing apparatus including pedestrian-oriented map databases, a route computation function for computing routes, and a communication function for communicating with said portable pedestrian guidance apparatus;
   a plurality of markers mounted at various locations in an installation, said markers outputting installation identification information and information emission direction information; and
   said portable pedestrian guidance apparatus constituted by a communication function for communicating with said route computation information providing apparatus and said markers, and by a position and direction measuring function.

7. A pedestrian navigation system according to claim 6, wherein said portable pedestrian guidance apparatus includes an information translation function for translating information sent either from said route computation information providing apparatus or from said markers into information in a format applicable to a use state of a user making use of said portable pedestrian guidance apparatus.

8. A pedestrian navigation system according to claim 7, wherein said information translation function comprises:

   a detecting part for detecting said use state of said user making use of said portable pedestrian guidance apparatus; a translation table defining beforehand relations of correspondence between a detected result from said detecting part and said use state of said user; a judging part for judging said use state of said user based on said detected result from said detecting part and on said translation table; and an information translating part for translating the information received by said receiving part in accordance with a judged result from said judging part.

FIG. 1

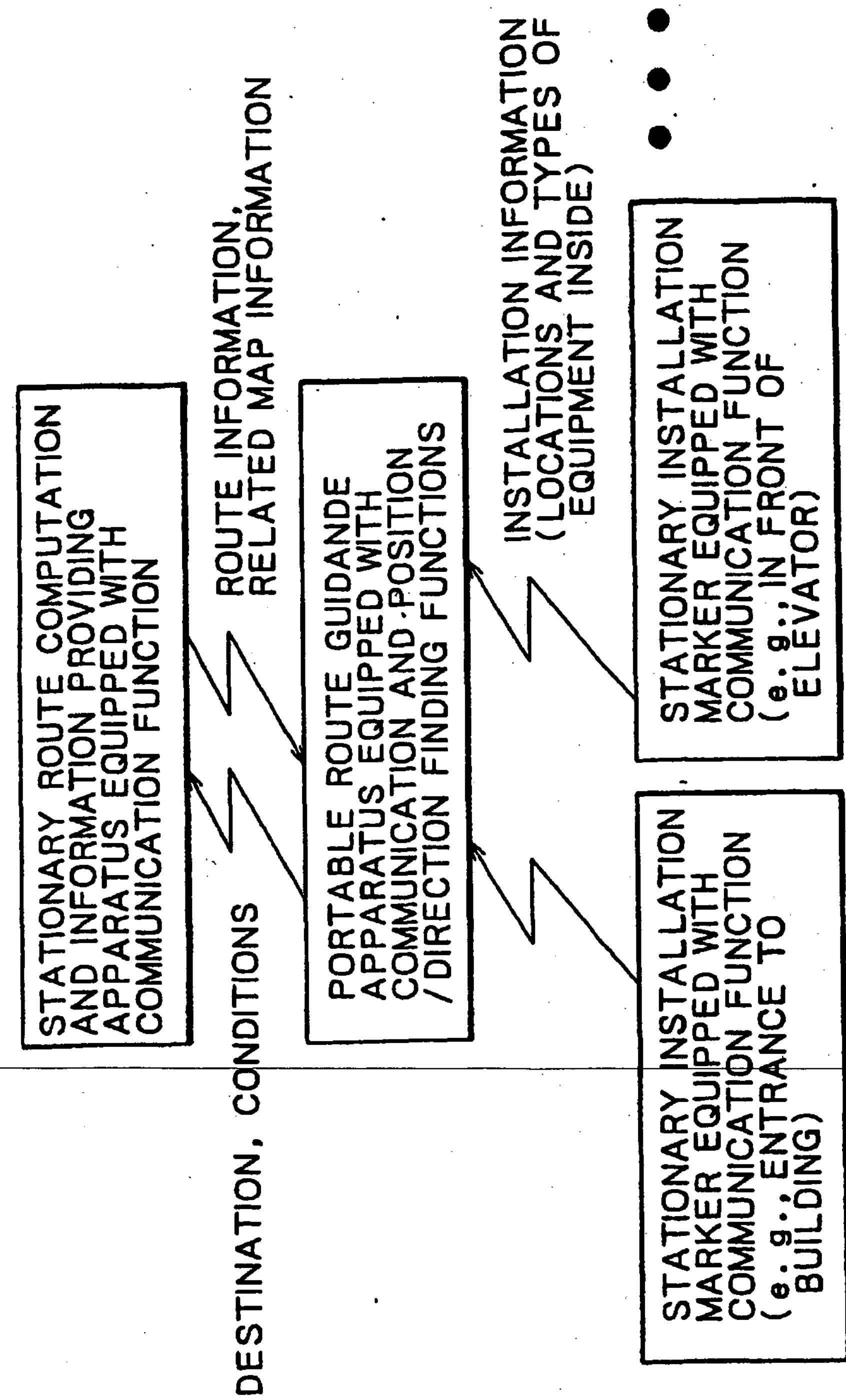

STATIONARY ROUTE COMPUTATION AND INFORMATION PROVIDING APPARATUS EQUIPPED WITH COMMUNICATION FUNCTION
ROUTE INFORMATION, RELATED MAP INFORMATION
DESTINATION, CONDITIONS
PORTABLE ROUTE GUIDANDE APPARATUS EQUIPPED WITH COMMUNICATION AND POSITION /DIRECTION FINDING FUNCTIONS
INSTALLATION INFORMATION (LOCATIONS AND TYPES OF EQUIPMENT INSIDE)
STATIONARY INSTALLATION MARKER EQUIPPED WITH COMMUNICATION FUNCTION (e.g., IN FRONT OF ELEVATOR)
STATIONARY INSTALLATION MARKER EQUIPPED WITH COMMUNICATION FUNCTION (e.g., ENTRANCE TO BUILDING)

FIG. 2

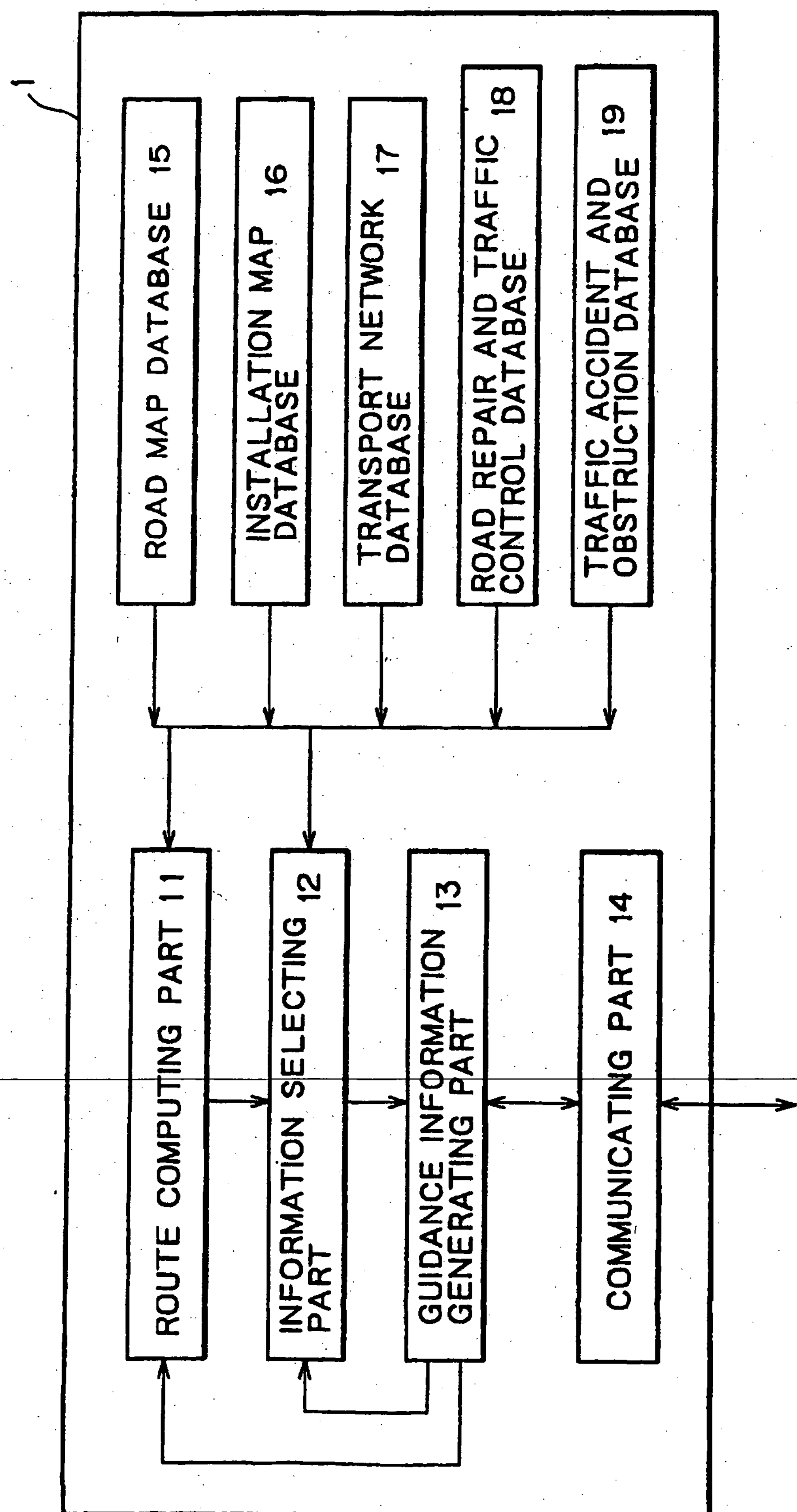

1
ROAD MAP DATABASE 15
INSTALLATION MAP DATABASE 16
TRANSPORT NETWORK DATABASE 17
ROAD REPAIR AND TRAFFIC CONTROL DATABASE 18
TRAFFIC ACCIDENT AND OBSTRUCTION DATABASE 19
ROUTE COMPUTING PART 11
INFORMATION SELECTING PART 12
GUIDANCE INFORMATION GENERATING PART 13
COMMUNICATING PART 14

FIG. 3

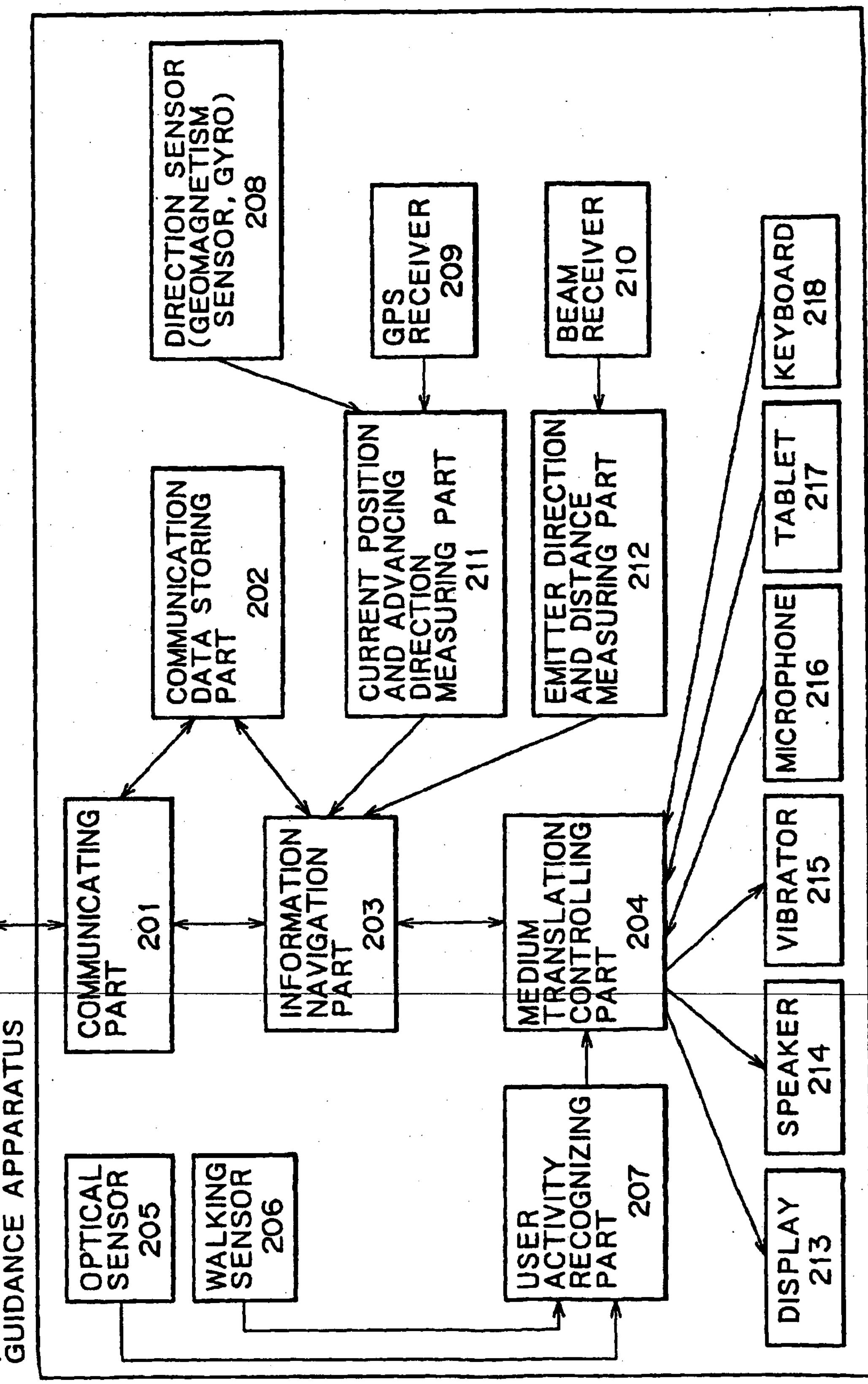

PORTABLE ROUTE GUIDANCE APPARATUS
COMMUNICATING PART 201
COMMUNICATION DATA STORING PART 202
INFORMATION NAVIGATION PART 203
MEDIUM TRANSLATION CONTROLLING PART 204
OPTICAL SENSOR 205
WALKING SENSOR 206
USER ACTIVITY RECOGNIZING PART 207
DIRECTION SENSOR (GEOMAGNETISM SENSOR, GYRO) 208
GPS RECEIVER 209
BEAM RECEIVER 210
CURRENT POSITION AND ADVANCING DIRECTION MEASURING PART 211
EMITTER DIRECTION AND DISTANCE MEASURING PART 212
DISPLAY 213
SPEAKER 214
VIBRATOR 215
MICROPHONE 216
TABLET 217
KEYBOARD 218

FIG. 4

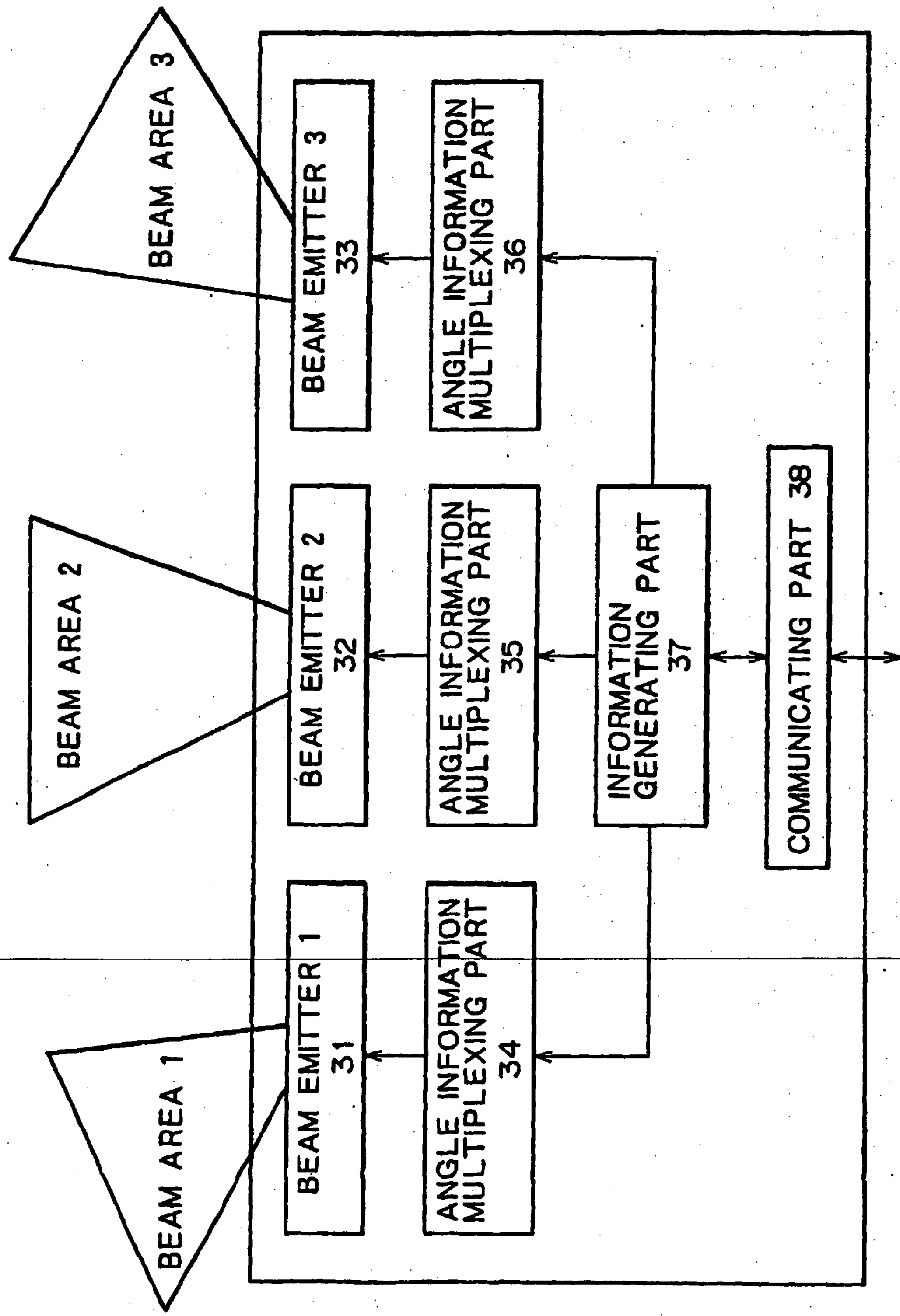

BEAM AREA 1
BEAM AREA 2
BEAM AREA 3
BEAM EMITTER 1 31
BEAM EMITTER 2 32
BEAM EMITTER 3 33
ANGLE INFORMATION MULTIPLEXING PART 34
ANGLE INFORMATION MULTIPLEXING PART 35
ANGLE INFORMATION MULTIPLEXING PART 36
INFORMATION GENERATING PART 37
COMMUNICATING PART 38

FIG. 5

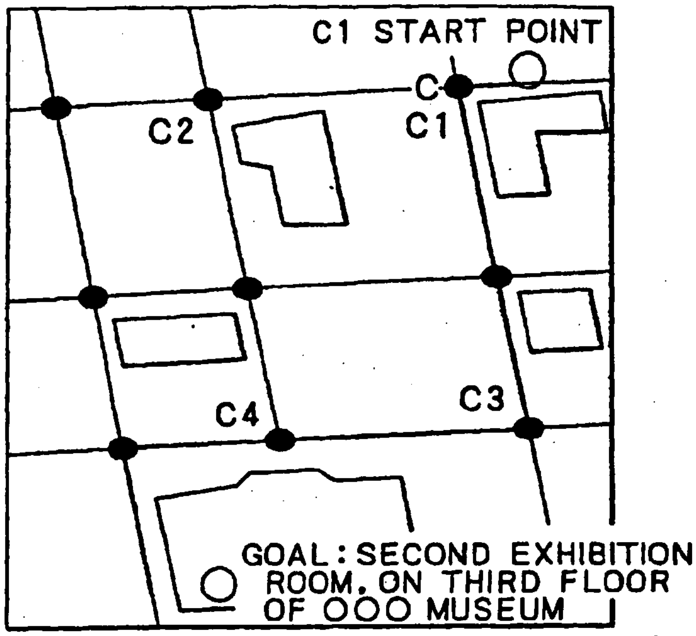

C1 START POINT
C
C2
C1
C4
C3
GOAL: SECOND EXHIBITION ROOM, ON THIRD FLOOR OF OOO MUSEUM

FIG. 6

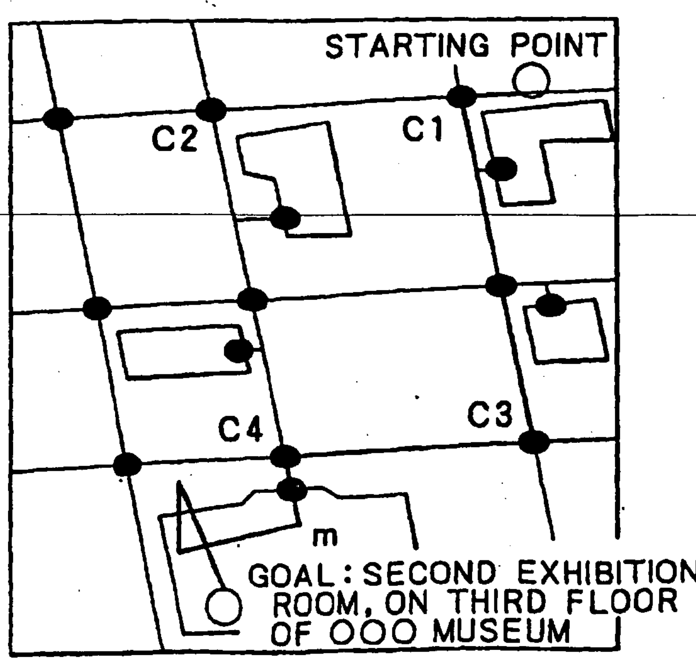

STARTING POINT
C2
C1
C4
C3
m
GOAL: SECOND EXHIBITION ROOM, ON THIRD FLOOR OF OOO MUSEUM

FIG. 7

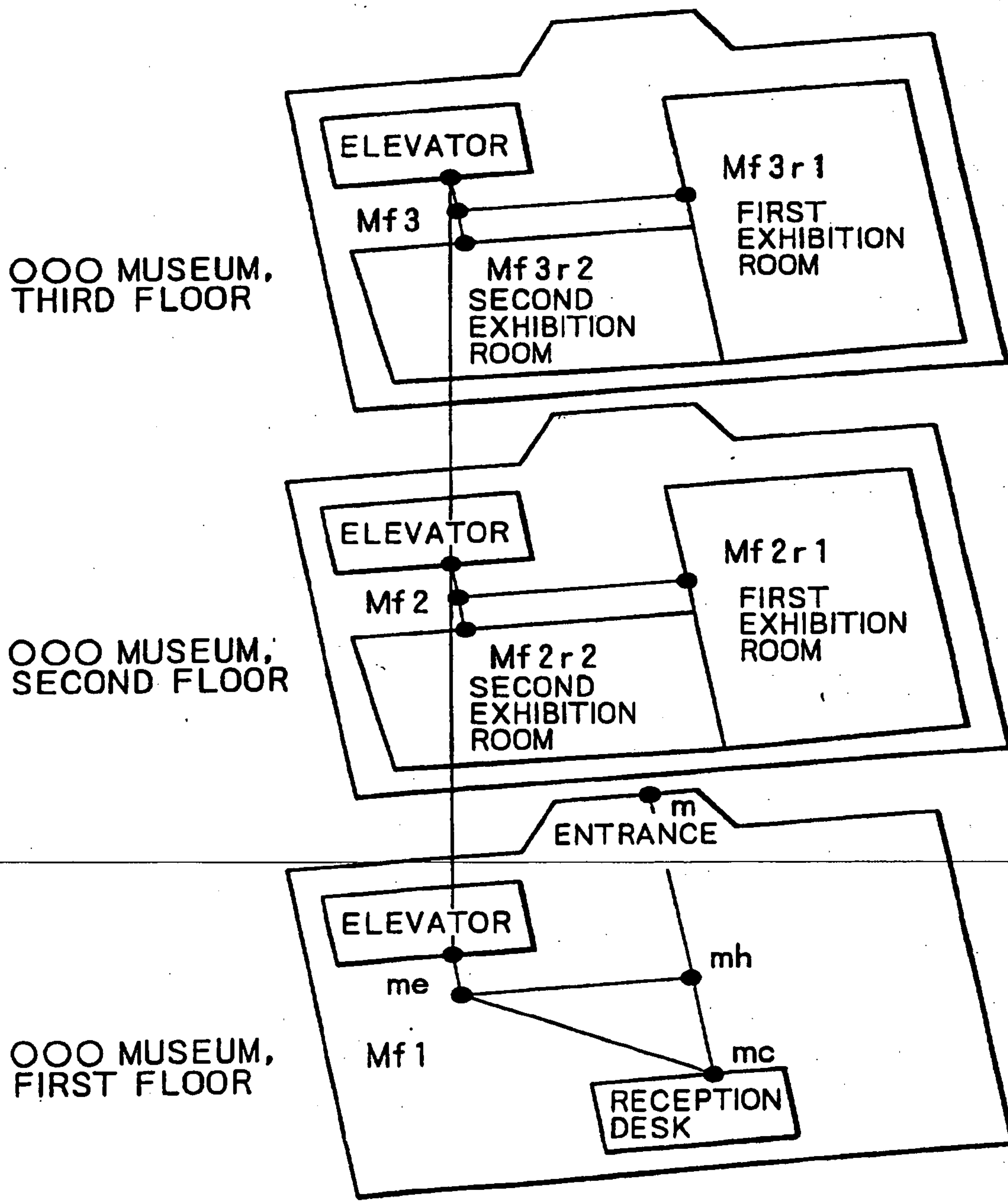

OOO MUSEUM, THIRD FLOOR
ELEVATOR
Mf 3
Mf 3 r 1
FIRST EXHIBITION ROOM
Mf 3 r 2
SECOND EXHIBITION ROOM
OOO MUSEUM, SECOND FLOOR
ELEVATOR
Mf 2
Mf 2 r 1
FIRST EXHIBITION ROOM
Mf 2 r 2
SECOND EXHIBITION ROOM
m
ENTRANCE
OOO MUSEUM, FIRST FLOOR
ELEVATOR
me
mh
Mf 1
mc
RECEPTION DESK

FIG. 8

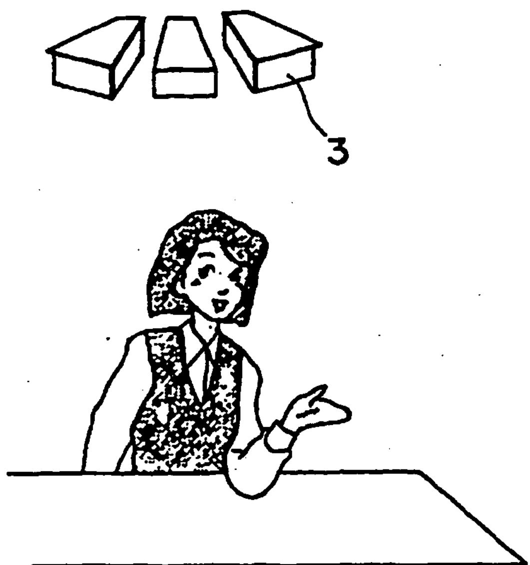
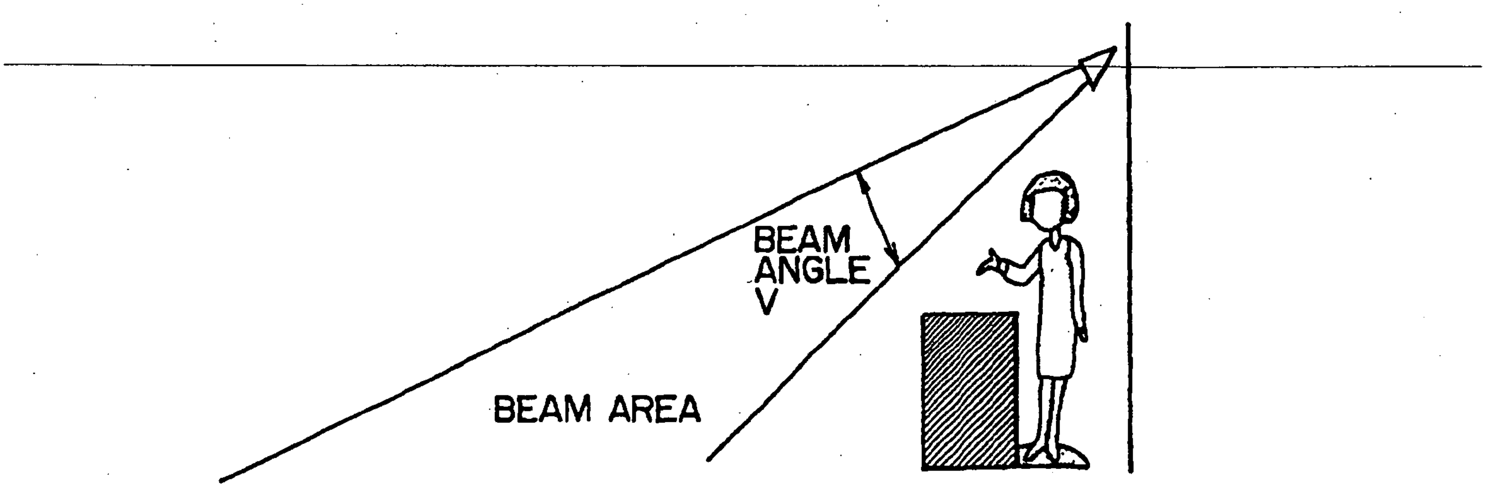


FIG. 9



F I G. 10

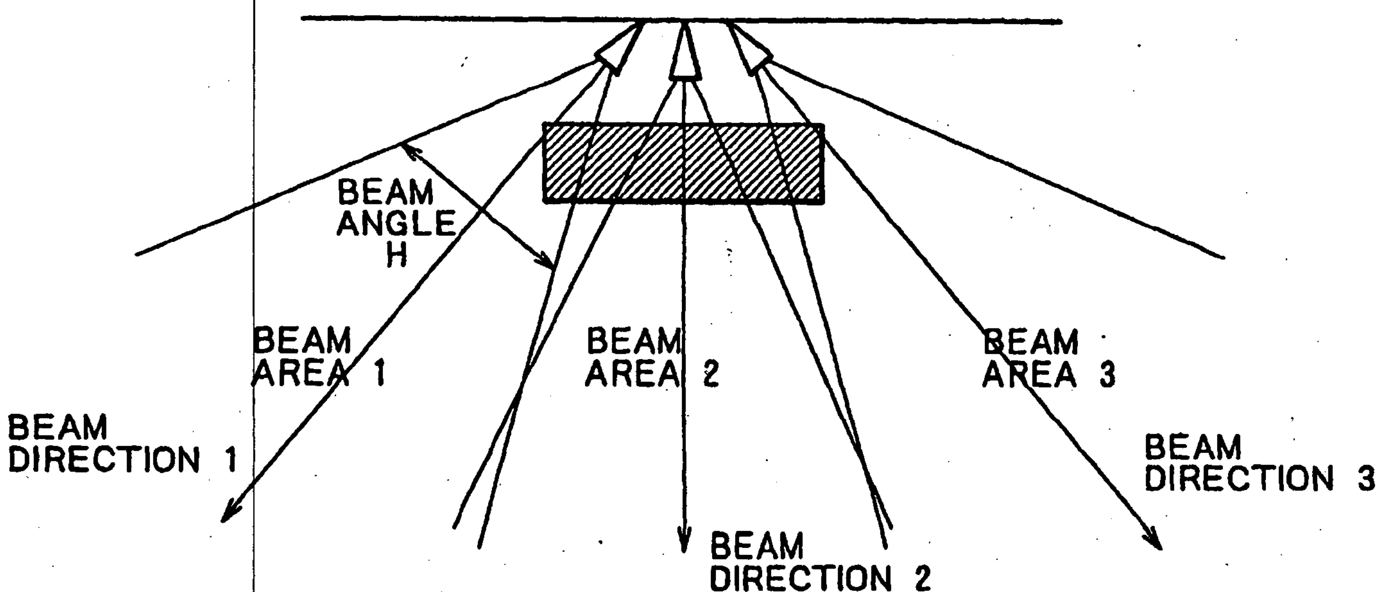

BEAM
ANGLE
H
BEAM
AREA 1
BEAM
AREA 2
BEAM
AREA 3
BEAM
DIRECTION 1
BEAM
DIRECTION 2
BEAM
DIRECTION 3

FIG. 11

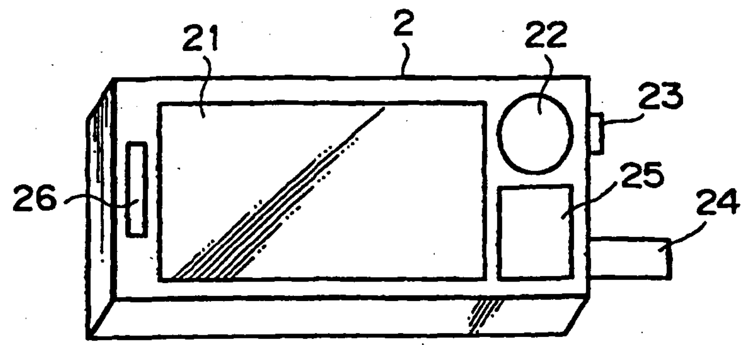

21
2
22
23
25
24
26

FIG. 12

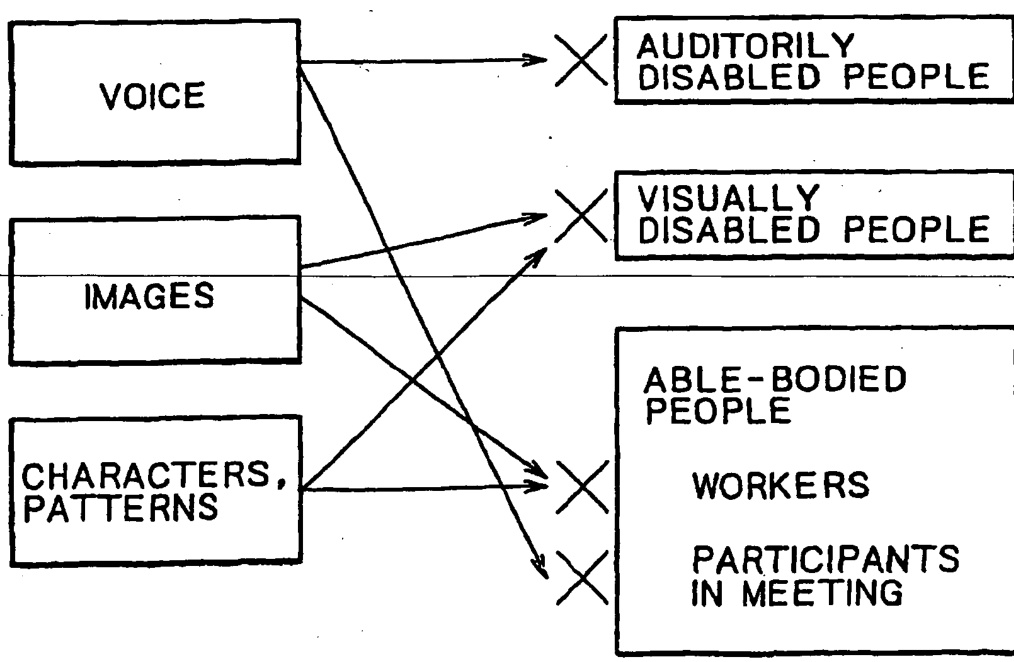

VOICE
IMAGES
CHARACTERS, PATTERNS
AUDITORILY DISABLED PEOPLE
VISUALLY DISABLED PEOPLE
ABLE-BODIED PEOPLE
WORKERS
PARTICIPANTS IN MEETING

FIG. 13

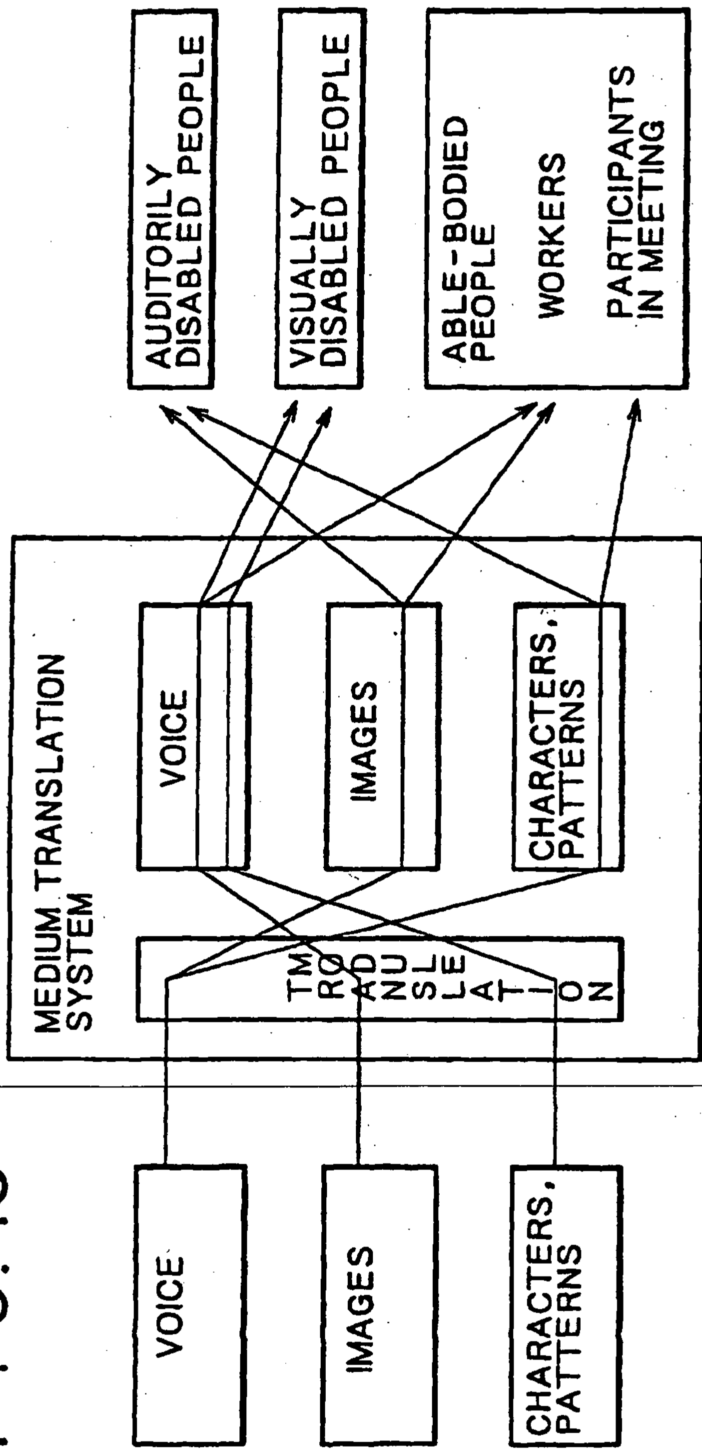

VOICE
IMAGES
CHARACTERS, PATTERNS
MEDIUM TRANSLATION SYSTEM
TRANSLATION
MODULE
VOICE
IMAGES
CHARACTERS, PATTERNS
AUDITORILY DISABLED PEOPLE
VISUALLY DISABLED PEOPLE
ABLE-BODIED PEOPLE
WORKERS
PARTICIPANTS IN MEETING

FIG. 14

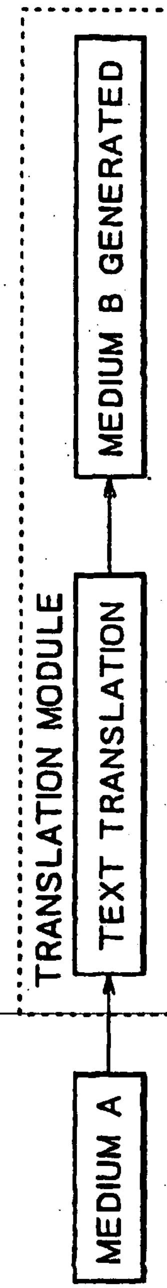

MEDIUM A
TRANSLATION MODULE
TEXT TRANSLATION
MEDIUM B GENERATED

FIG. 15

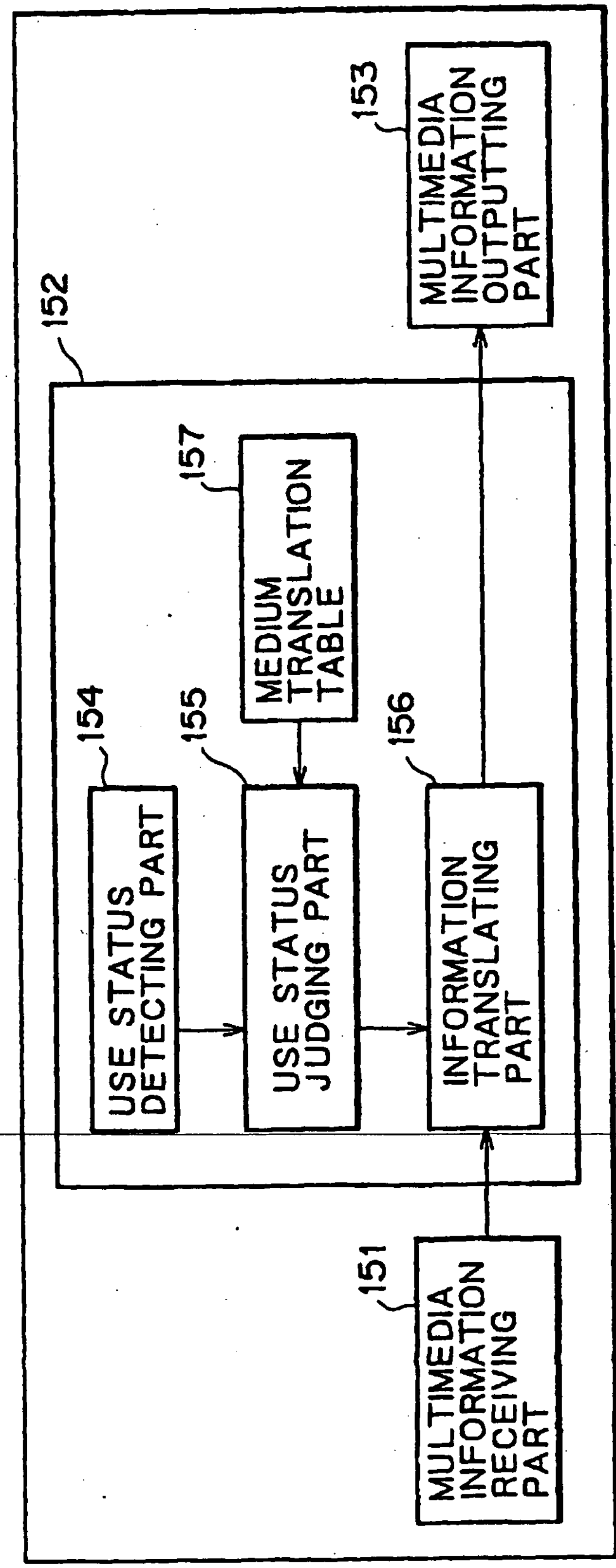

152
153
MULTIMEDIA INFORMATION OUTPUTTING PART
157
MEDIUM TRANSLATION TABLE
154
USE STATUS DETECTING PART
155
USE STATUS JUDGING PART
156
INFORMATION TRANSLATING PART
151
MULTIMEDIA INFORMATION RECEIVING PART

FIG. 16A

LOCATION NAMES (ID)	POSITIONS (POS)	BEAM DIRECTIONS (BD)	LINKS
BUILDING A	LAT. a1, LONG. a2	315 DEG., 0 DEG., 45 DEG.	C1
....	....	....	....
OOO MUSEUM m	LAT. m1, LONG. m2	315 DEG., 0 DEG., 45 DEG.	mh, C4
....	....	....	....
CROSSING C1	LAT. c11, LONG. c12	0 DEG., 90 DEG., 180 DEG., 270 DEG.	C2, C3
CROSSING C2	LAT. c21, LONG. c22	0 DEG., 90 DEG., 180 DEG., 270 DEG.	C1, C4
CROSSING C3	LAT. c31, LONG. c32	0 DEG., 90 DEG., 180 DEG., 270 DEG.	C1, C4
CROSSING C4	LAT. c41, LONG. c42	0 DEG., 90 DEG., 180 DEG., 270 DEG.	C2, C3
....	....	....	....

F I G. 16B

LOCATION NAMES (ID)	POSITIONS (POS)	BEAM DIRECTIONS (BD)	LINKS
OOO MUSEUM m	LAT. m1, LONG. m2	315 DEG., 0 DEG., 45 DEG.	mh, C4
HALL mh, SAME MUSEUM	LAT. mh1, LONG. mh2	315 DEG., 0 DEG., 45 DEG.	m, me
ELEVATOR me, SAME MUSEUM	LAT. me1, LONG. me2	135 DEG., 180 DEG., 270 DEG.	connect mf1, mf2, mf3
FIRST FLOOR mf1, SAME MUSEUM	DO.	315 DEG., 0 DEG., 45 DEG.	me
....	....	....	....
THIRD FLOOR mf3, SAME MUSEUM	DO.	315 DEG., 0 DEG., 45 DEG.	me
SECOND EXHIBITION ROOM mf3r2, SAME MUSEUM	LAT. mr1, LONG. mr2	315 DEG., 0 DEG., 45 DEG.	mf3
....	....	....	....

F I G. 17

NAMES OF MEDIATING LOCATIONS (ID)	POSITIONS OF MEDIATING LOCATIONS (POS)	APPROACH DIRECTIONS (Din)	DEPARTURE DIRECTIONS (Dout)
BUILDING A	LAT. a1, LONG. a2	270 DEG.	270 DEG.
CROSSING C1	LAT. c11, LONG. c12	270 DEG.	180 DEG.
CROSSING C3	LAT. c31, LONG. c32	180 DEG.	270 DEG.
CROSSING C4	LAT. c41, LONG. c42	270 DEG.	180 DEG.
OOO MUSEUM m	LAT. m1, LONG. m2	180 DEG.	180 DEG.
HALL mh, SAME MUSEUM	LAT. mh1, LONG. mh2	180 DEG.	300 DEG.
ELEVATOR me, SAME MUSEUM	LAT. me1, LONG. me2	300 DEG.	0 DEG.
THIRD FLOOR mf3, SAME MUSEUM	DO.	180 DEG.	180 DEG.
SECOND EXHIBITION ROOM mf3r2, SAME MUSEUM	LAT. mr1, LONG. mr2	180 DEG.	180 DEG.

FIG. 18

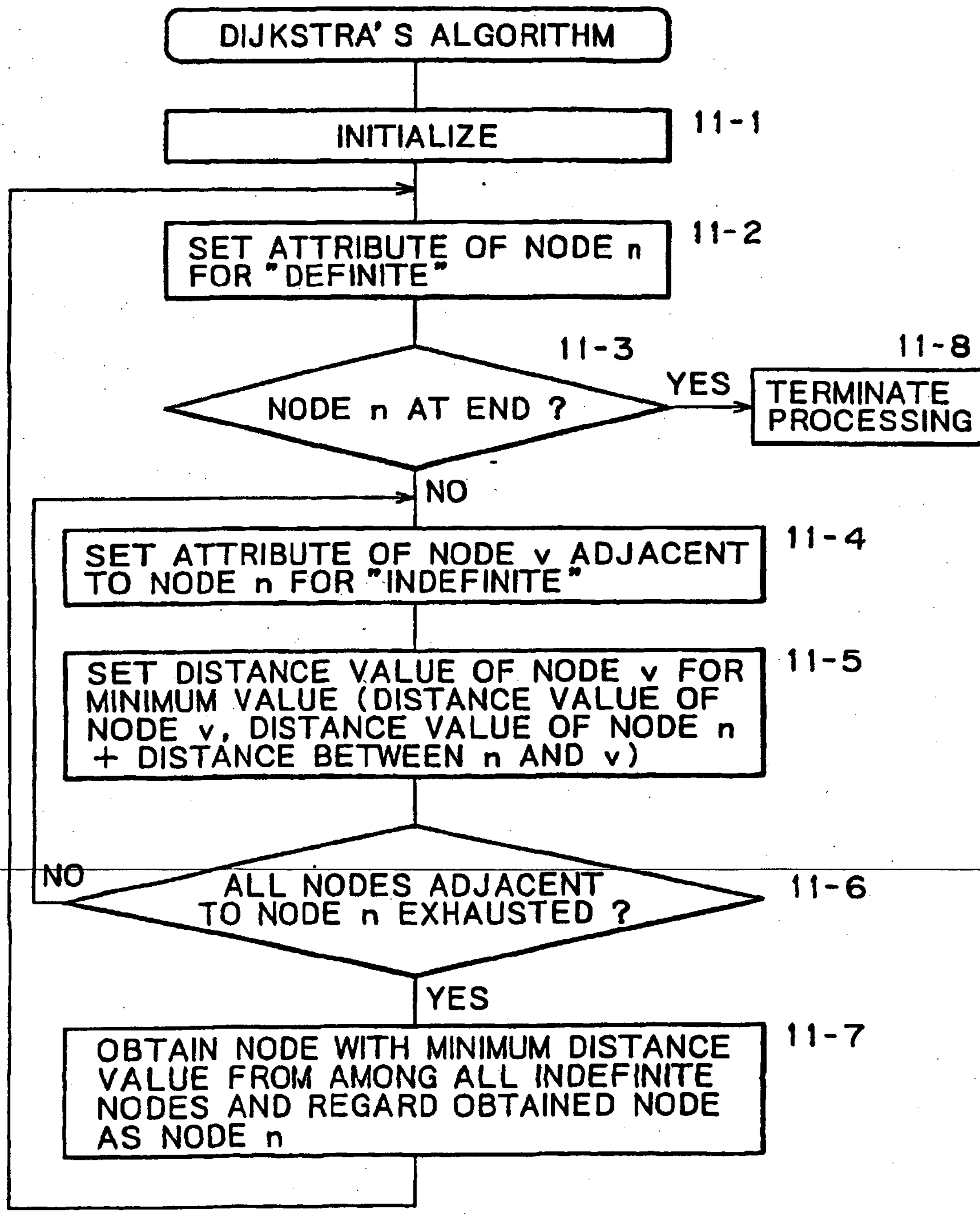
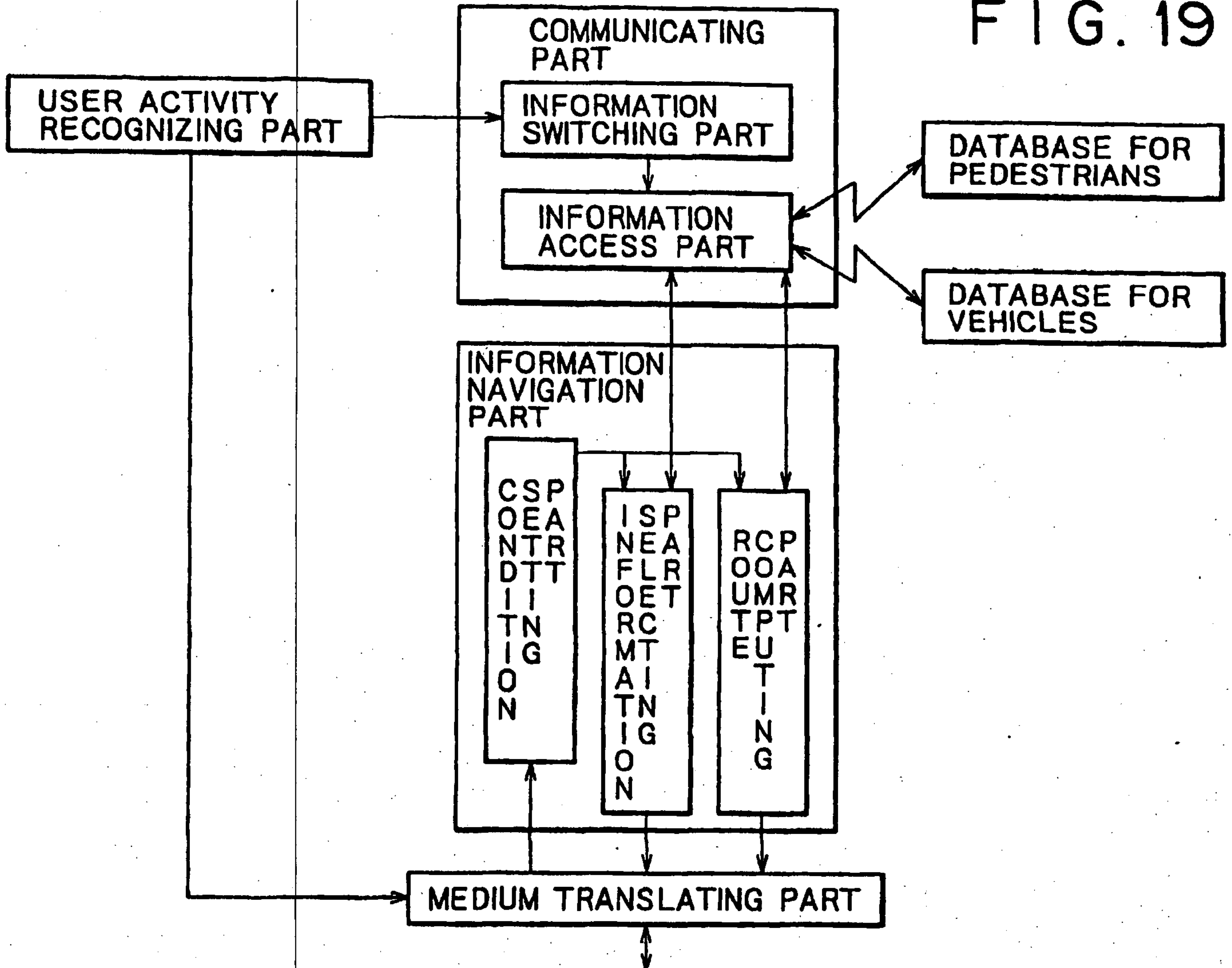

DIJKSTRA'S ALGORITHM
INITIALIZE
11-1
SET ATTRIBUTE OF NODE n FOR "DEFINITE"
11-2
11-3
NODE n AT END ?
YES
11-8
TERMINATE PROCESSING
NO
SET ATTRIBUTE OF NODE v ADJACENT TO NODE n FOR "INDEFINITE"
11-4
SET DISTANCE VALUE OF NODE v FOR MINIMUM VALUE (DISTANCE VALUE OF NODE v, DISTANCE VALUE OF NODE n + DISTANCE BETWEEN n AND v)
11-5
NO
ALL NODES ADJACENT TO NODE n EXHAUSTED ?
11-6
YES
OBTAIN NODE WITH MINIMUM DISTANCE VALUE FROM AMONG ALL INDEFINITE NODES AND REGARD OBTAINED NODE AS NODE n
11-7

FIG. 19



USER ACTIVITY RECOGNIZING PART
COMMUNICATING PART
INFORMATION SWITCHING PART
INFORMATION ACCESS PART
DATABASE FOR PEDESTRIANS
DATABASE FOR VEHICLES
INFORMATION NAVIGATION PART
CONDITION SETTING PART
INFORMATION SELECTING PART
ROUTE COMPUTING PART
MEDIUM TRANSLATING PART

FIG. 20

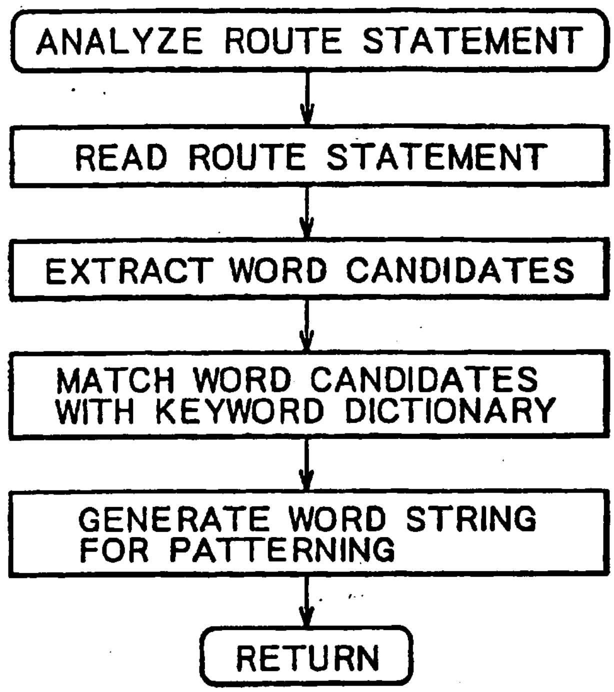

ANALYZE ROUTE STATEMENT
READ ROUTE STATEMENT
EXTRACT WORD CANDIDATES
MATCH WORD CANDIDATES WITH KEYWORD DICTIONARY
GENERATE WORD STRING FOR PATTERNING
RETURN

FIG. 21

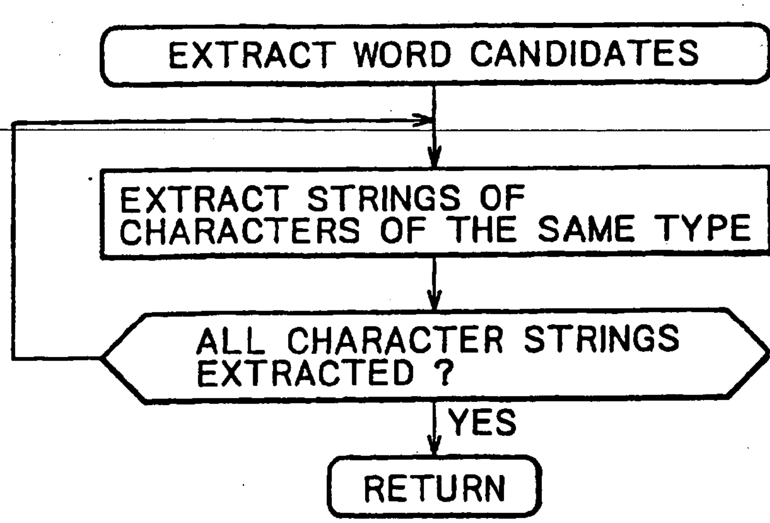

EXTRACT WORD CANDIDATES
EXTRACT STRINGS OF CHARACTERS OF THE SAME TYPE
ALL CHARACTER STRINGS EXTRACTED ?
YES
RETURN

FIG. 22

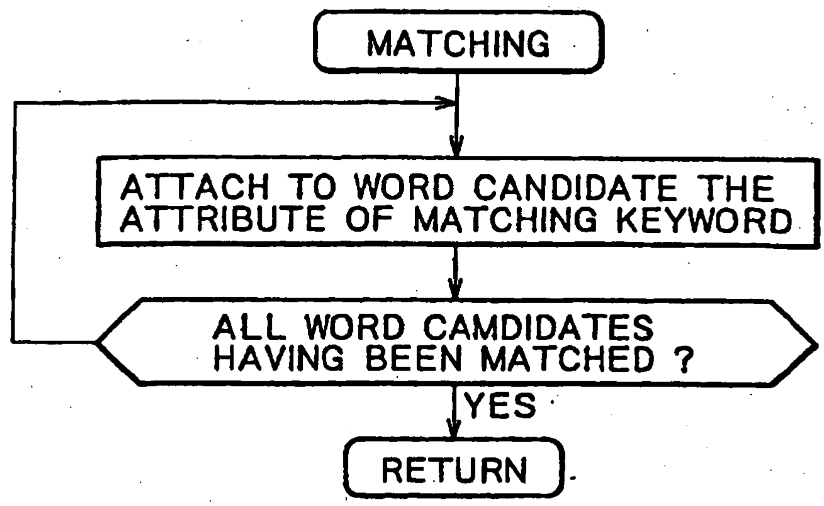
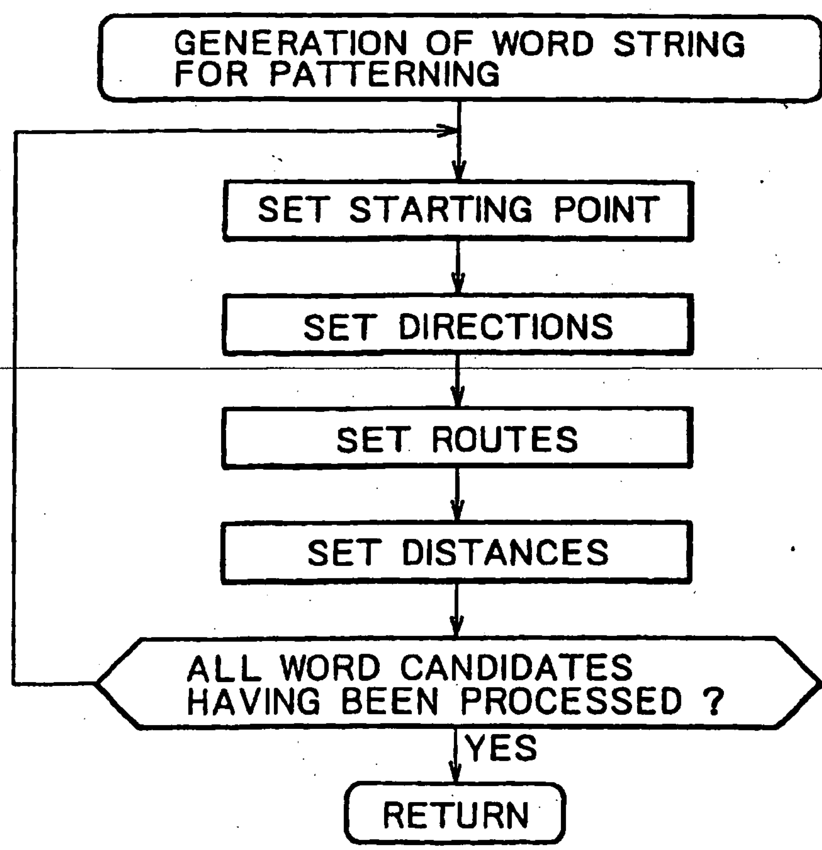

MATCHING
ATTACH TO WORD CANDIDATE THE ATTRIBUTE OF MATCHING KEYWORD
ALL WORD CAMDIDATES HAVING BEEN MATCHED ?
YES
RETURN

FIG. 23


GENERATION OF WORD STRING FOR PATTERNING
SET STARTING POINT
SET DIRECTIONS
SET ROUTES
SET DISTANCES
ALL WORD CANDIDATES HAVING BEEN PROCESSED ?
YES
RETURN

F I G. 24

INPUT CHARACTER STRING : TYPICAL ROUTE GUIDANCE STATEMENT FOR GUIDANCE FROM STATION A TO BUILDING B

"PROCEED 300m NORTH ALONG MAIN STREET FROM NORTH EXIT OF STATION A, TURN RIGHT AT CROSSING, ADVANCE KEYAKI AVENUE UP TO BUILDING B, FOURTH INSTALLATION ON THE RIGHT"

KEYS

POSITIONS : ** STATION, ** BUILDING, CROSSING, TRAFFIC LIGHTS

DIRECTIONS : CARDINAL POINTS (__ EXIT, TURN AT __), RIGHT OR LEFT (NEAR __, ALONG __, ON __ SIDE)

ROUTES : ** AVENUE, NATIONAL ROUTE NO. __, PREFECTURAL ROUTE

DISTANCES : m, km, n-TH INSTALLATION FROM **

ANALYSIS OF ROUTE GUIDANCE STATEMENT

POSITIONS : STATION A, CROSSING, BUILDING B

DIRECTIONS : NORTH EXIT OF STATION A, ADVANCE NORTH ALONG MAIN STREET FROM STATION, RIGHT TURN AT CROSSING, ON RIGHT SIDE OF KEYAKI AVENUE

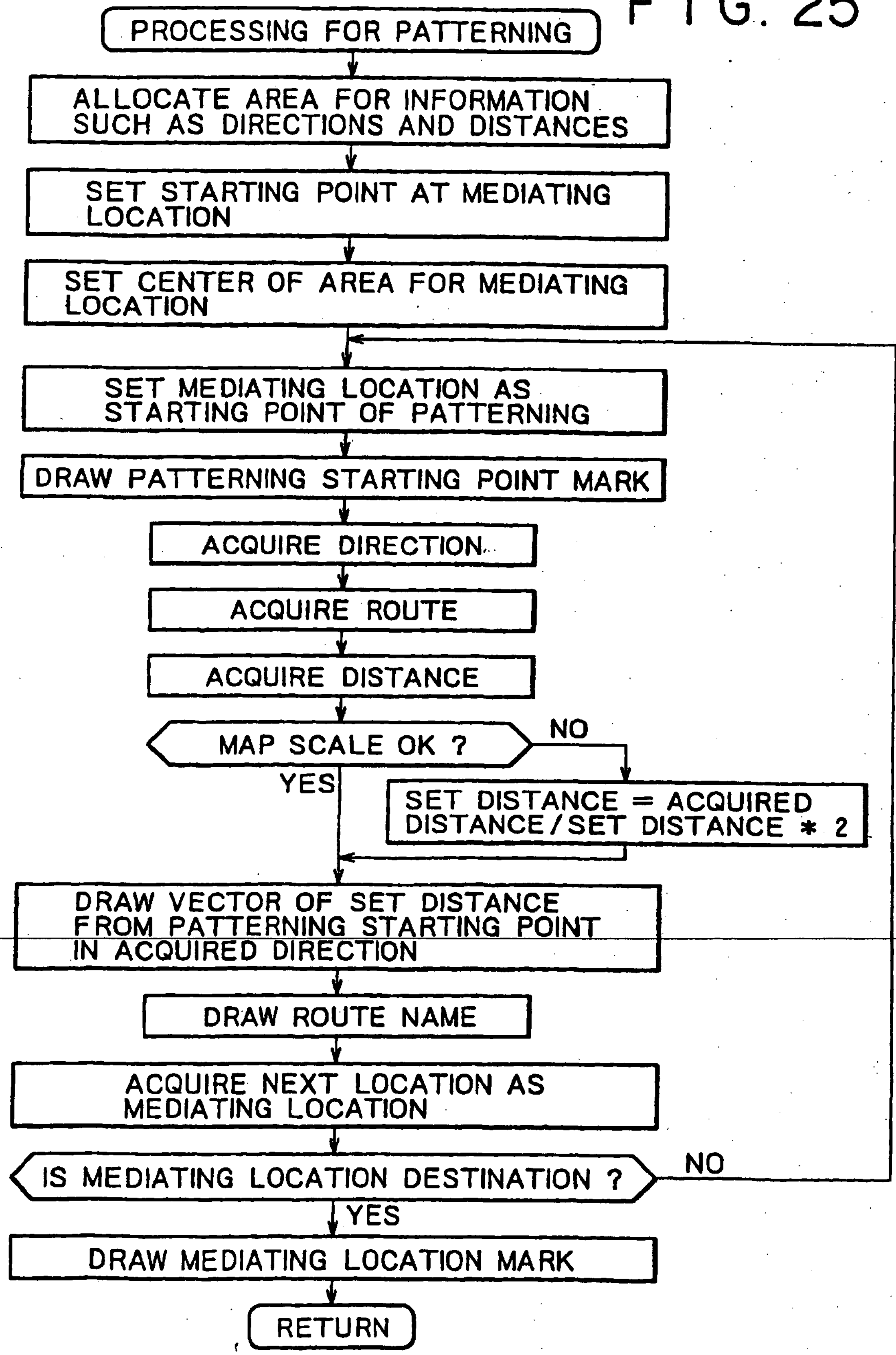
ROUTES : MAIN STREET IN FRONT OF STATION, KEYAKI AVENUE

DISTANCES : 300m, FOURTH BUILDING

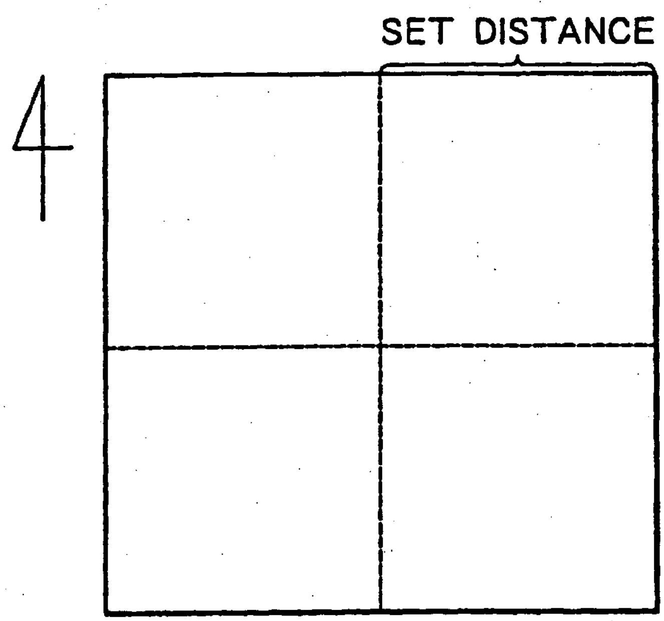
PATTERNING

STARTING POINT : STATION A ; DIRECTION : NORTH OF NORTH EXIT AT STATION A ; ROUTE : MAIN STREET IN FRONT OF STATION ; DISTANCE : 300m ; MEDIATING LOCATION : CROSSING ; DIRECTION : RIGHT TURN ; ROUTE : KEYAKI AVENUE ; DISTANCE : FOURTH BUILDING ; DESTINATION : BUILDING B ; DIRECTION : RIGHT-HAND SIDE

FIG. 25


PROCESSING FOR PATTERNING
ALLOCATE AREA FOR INFORMATION SUCH AS DIRECTIONS AND DISTANCES
SET STARTING POINT AT MEDIATING LOCATION
SET CENTER OF AREA FOR MEDIATING LOCATION
SET MEDIATING LOCATION AS STARTING POINT OF PATTERNING
DRAW PATTERNING STARTING POINT MARK
ACQUIRE DIRECTION
ACQUIRE ROUTE
ACQUIRE DISTANCE
MAP SCALE OK ?
NO
YES
SET DISTANCE = ACQUIRED DISTANCE / SET DISTANCE * 2
DRAW VECTOR OF SET DISTANCE FROM PATTERNING STARTING POINT IN ACQUIRED DIRECTION
DRAW ROUTE NAME
ACQUIRE NEXT LOCATION AS MEDIATING LOCATION
IS MEDIATING LOCATION DESTINATION ?
NO
YES
DRAW MEDIATING LOCATION MARK
RETURN

F I G. 26



F I G. 27

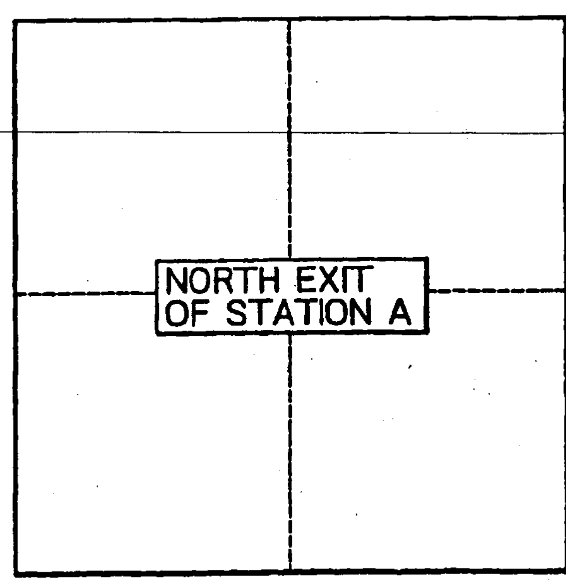


FIG. 28

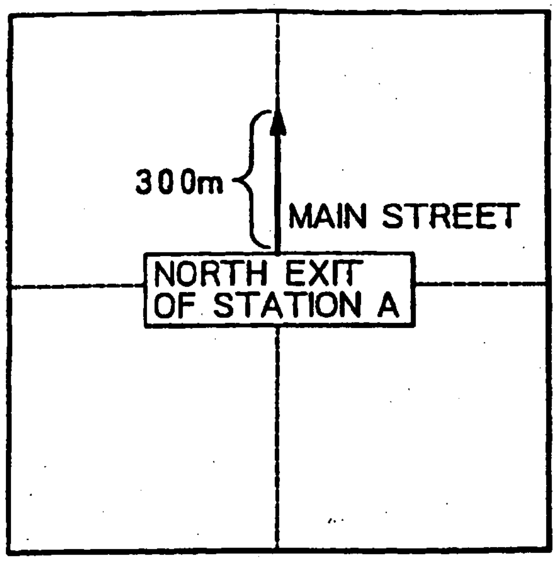

300m
MAIN STREET
NORTH EXIT
OF STATION A

FIG. 29

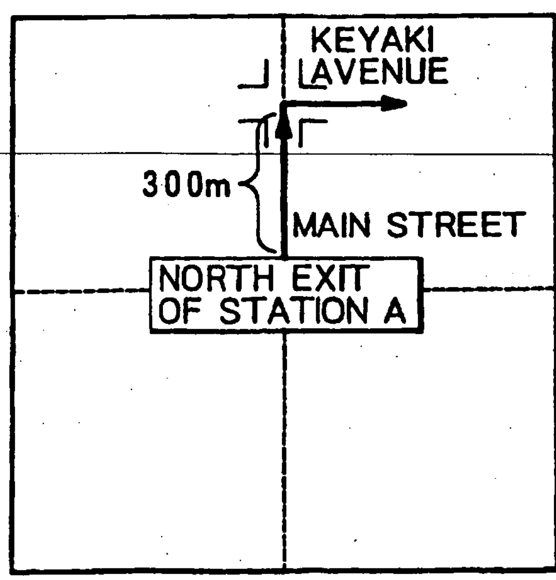

KEYAKI
AVENUE
300m
MAIN STREET
NORTH EXIT
OF STATION A

FIG. 30

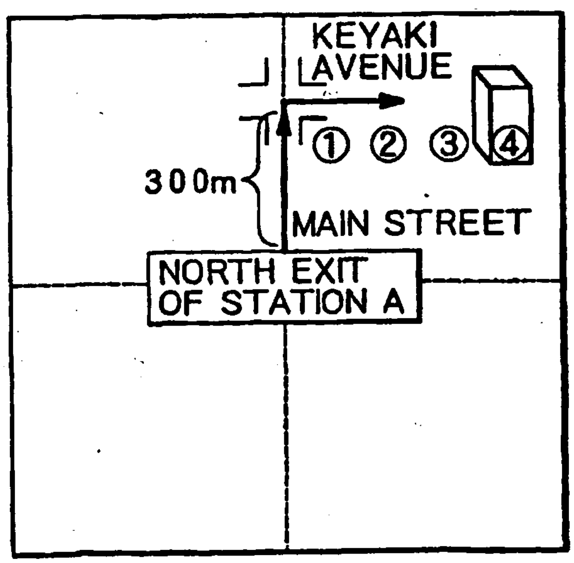


FIG. 31

JUDGED STATE	SENSOR OUTPUT			TRANSLATION BETWEEN INFORMATION MEDIA			
	LIGHT INTENSITY	ACCELERATION	SOUND VOLUME	CHARACTERS	PATTERNS	IMAGES	VOICE
STATIONARY (STOPPING)	HIGH (BRIGHT)	CONSTANT IN DIRECTION OF GRAVITY	LOW	NO TRANSLATION	NO TRANSLATION	NO TRANSLATION	NO TRANSLATION
STATIONARY (STOPPING)	HIGH (BRIGHT)	CONSTANT IN DIRECTION OF GRAVITY	HIGH	NO TRANSLATION	NO TRANSLATION	NO TRANSLATION	TRANSLATED INTO CHARACTERS
STATIONARY (STOPPING)	LOW (DARK)	CONSTANT IN DIRECTION OF GRAVITY	LOW	TRANSLATED INTO VOICE	TRANSLATED INTO VOICE	TRANSLATED INTO VOICE	NO TRANSLATION
STATIONARY (STOPPING)	LOW (DARK)	CONSTANT IN DIRECTION OF GRAVITY	HIGH	TRANSLATED INTO VOICE	TRANSLATED INTO VOICE	TRANSLATED INTO VOICE	NO TRANSLATION
WALKING	HIGH (BRIGHT)	GRAVITY + ADVANCING DIRECTION	LOW	TRANSLATED INTO PATTERNS	NO TRANSLATION	NO TRANSLATION	NO TRANSLATION
WALKING	HIGH (BRIGHT)	GRAVITY + ADVANCING DIRECTION	HIGH	TRANSLATED INTO PATTERNS	NO TRANSLATION	NO TRANSLATION	TRANSLATED INTO CHARACTERS
WALKING	LOW (DARK)	GRAVITY + ADVANCING DIRECTION	LOW	TRANSLATED INTO VOICE	TRANSLATED INTO VOICE	TRANSLATED INTO VOICE	NO TRANSLATION
WALKING	LOW (DARK)	GRAVITY + ADVANCING DIRECTION	HIGH	SPECIFIED BY USER	SPECIFIED BY USER	SPECIFIED BY USER	SPECIFIED BY USER
• •	• •	• •	• •	• •	• •	• •	• •

FIG. 32

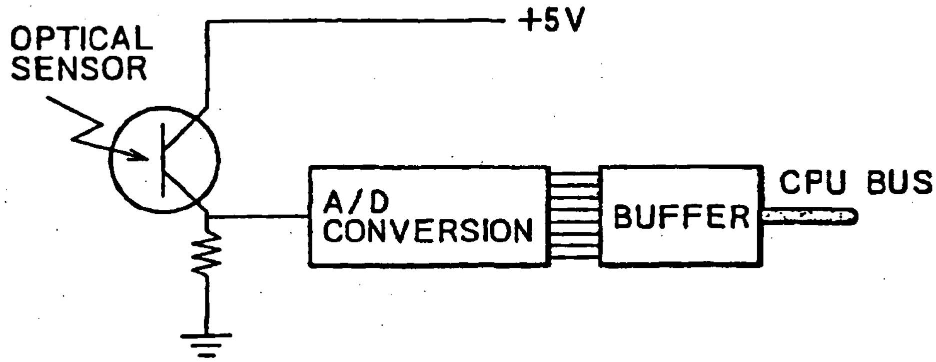

OPTICAL
SENSOR
+5V
A/D
CONVERSION
BUFFER
CPU BUS

FIG. 33

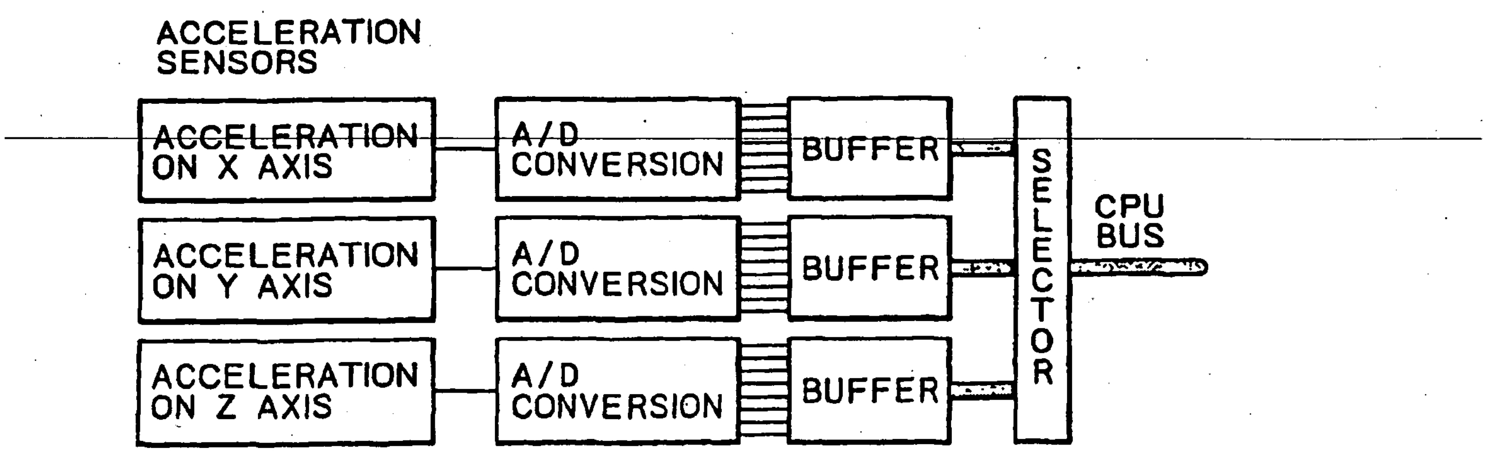

ACCELERATION
SENSORS
ACCELERATION
ON X AXIS
ACCELERATION
ON Y AXIS
ACCELERATION
ON Z AXIS
A/D
CONVERSION
A/D
CONVERSION
A/D
CONVERSION
BUFFER
BUFFER
BUFFER
SELECTOR
CPU
BUS

FIG. 34

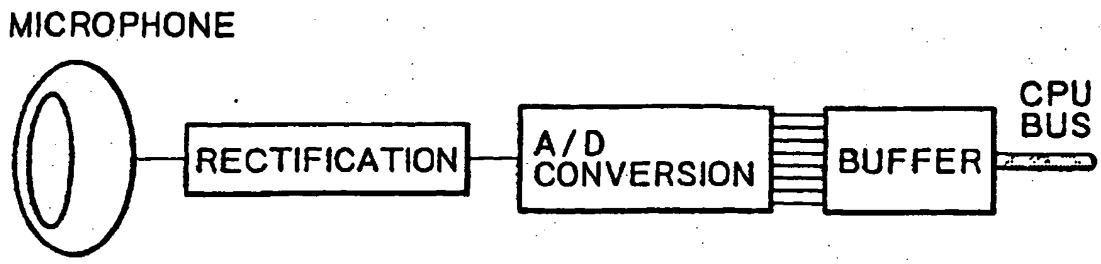

MICROPHONE
RECTIFICATION
A/D CONVERSION
BUFFER
CPU BUS

FIG. 35

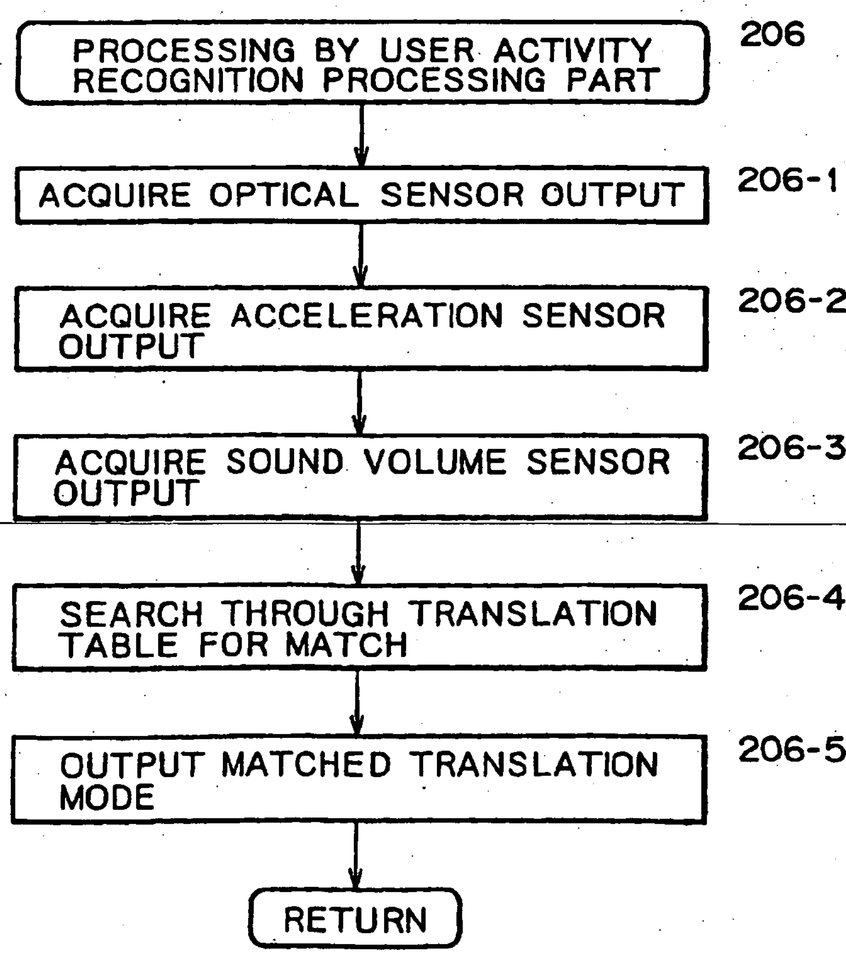
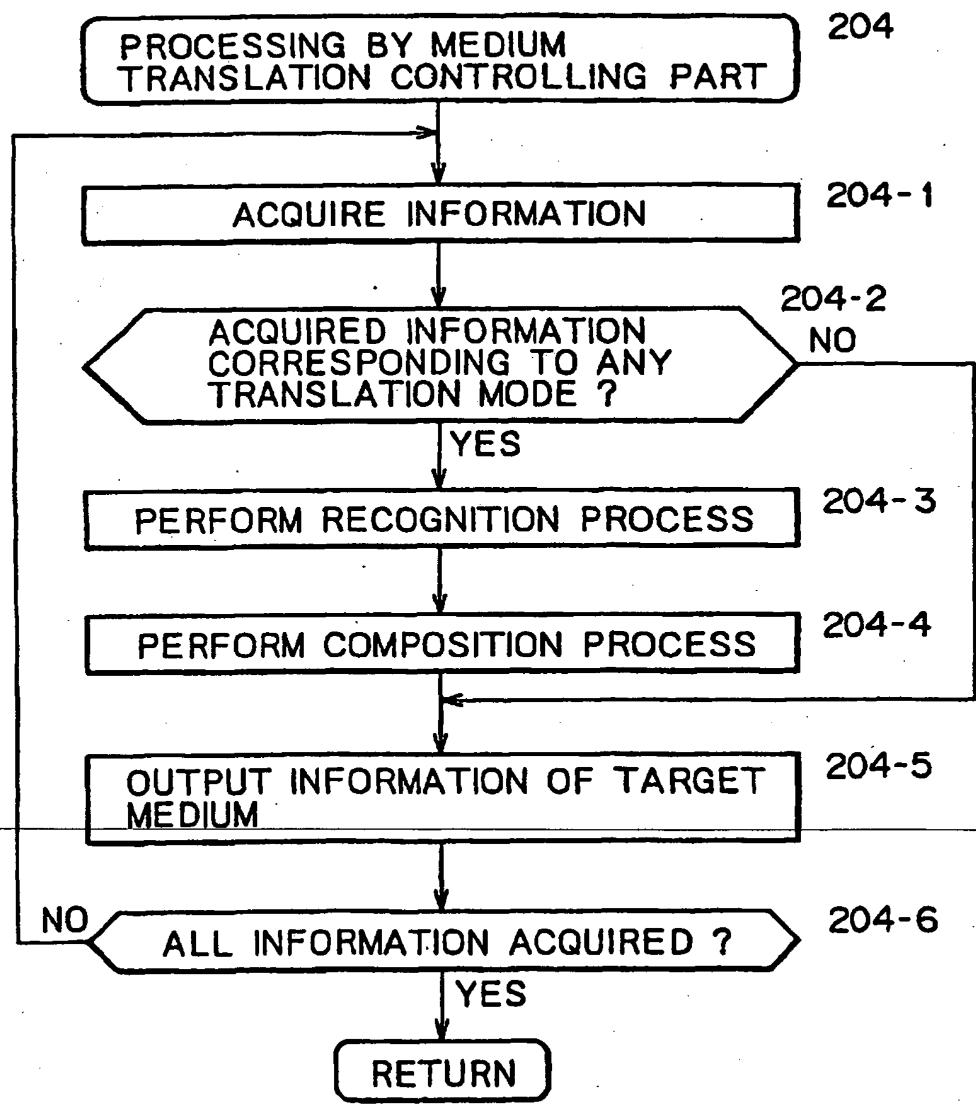

PROCESSING BY USER ACTIVITY RECOGNITION PROCESSING PART
206
ACQUIRE OPTICAL SENSOR OUTPUT
206-1
ACQUIRE ACCELERATION SENSOR OUTPUT
206-2
ACQUIRE SOUND VOLUME SENSOR OUTPUT
206-3
SEARCH THROUGH TRANSLATION TABLE FOR MATCH
206-4
OUTPUT MATCHED TRANSLATION MODE
206-5
RETURN

FIG. 36


PROCESSING BY MEDIUM TRANSLATION CONTROLLING PART
204
ACQUIRE INFORMATION
204-1
ACQUIRED INFORMATION CORRESPONDING TO ANY TRANSLATION MODE ?
204-2
NO
YES
PERFORM RECOGNITION PROCESS
204-3
PERFORM COMPOSITION PROCESS
204-4
OUTPUT INFORMATION OF TARGET MEDIUM
204-5
ALL INFORMATION ACQUIRED ?
204-6
NO
YES
RETURN

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP98/02151

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl^6 G01C21/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int.Cl^6 G01C21/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho	1926-1996	Toroku Jitsuyo Shinan Koho	1994-1998
Kokai Jitsuyo Shinan Koho	1971-1998	Jitsuyo Shinan Toroku Koho	1996-1998

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP, 8-171558, A (Saburo Tanatsugi), July 2, 1996 (02. 07. 96) (Family: none)	1-5
A	JP, 9-282589, A (Nippon Telegraph & Telephone Corp.), October 31, 1997 (31. 10. 97) (Family: none)	6-8
A	JP, 9-126804, A (Toyota Motor Corp.), May 16, 1997 (16. 05. 97) (Family: none)	6-8

☐ ~~Further documents are listed in the continuation of Box C.~~ ☐ ~~See patent family annex.~~

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
August 7, 1998 (07. 08. 98)	August 18, 1998 (18. 08. 98)

Name and mailing address of the ISA/	Authorized officer
Japanese Patent Office	
Facsimile No.	Telephone No.